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Abstracts and Indexes
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Items are identified by months, as follows:

<u>Month</u>	<u>Number</u>
January	Proceedings Papers 861 to 878
February	879 to 905
March	906 to 924
April	925 to 960
May	961 to 989
June	990 to 1018
July	1019 to 1033
August	1034 to 1053
September	1054 to 1069
October	1070 to 1095
November	1096 to 1112
December	1113 to 1135

Abstracts

January

861. Rupture Surfaces in Sand under Oblique Loads, by Alfreds R. Jumikis. (SM) Some results obtained by the author from experimental research in psomma-mechanics made from 1939 to 1942 are reported. This research pertains to deformation in soil—the shape of the shearing or rupture surface in dry sand soil caused by an obliquely loaded foundation model. The phenomena involved are examined, and relevant mathematical expressions are given. It is shown that the shearing surfaces can be represented by particular types of logarithmic spirals, depending on the type of soil.

862. Basic Concepts on the Compaction of Soil, by C. Y. Li. (SM) The soil compaction process is considered on a rational basis, and basic concepts of the problems involved are presented. The law of conservation of energy is employed to interpret how energy is spent. The influence of various factors on the behavior of a soil mass during compaction is explained. The "stage compaction" concept is introduced, and the effect of gravel content on the compaction of fine soil fractions is presented.

863. Vibrations of Beams on Many Supports, by John W. Miles. (EM) The natural frequencies of a continuous beam resting on an arbitrary number of uniformly

Note: Paper 1135 is part of the copyrighted Journal of the Board of Direction of the American Society of Civil Engineers, Vol. 82, BD 1, December, 1956.

spaced supports are determined from a difference equation formulation. These frequencies fall in periodically spaced groups separated by spectral gaps of widths equal to approximately half the interval between the natural frequencies of a single beam on a square root frequency scale. Wave propagation along an infinite, periodically supported beam is discussed, and the phase and group velocities are evaluated as functions of frequency.

864. Control of Underseepage, Mississippi River Levees, St. Louis District, CE, by C. I. Mansur and R. I. Kaufman. (SM) The paper contains descriptions of the underseepage problem along Mississippi River levees and of procedures used to design seepage-control measures. Included are the investigations conducted, methods of seepage control, examples of design of control measures, and construction procedures used to install the control measures.

865. Structural Rigidity in Calculating Settlements, by Samuel Chamecki. (SM) A solution for the problem of interaction between a structure and its foundation, based on a system of simultaneous equations, is systematized by a set of objective operations. The method involves a simple system of successive corrections and is adaptable to any set of assumptions pertaining to the behavior of the soil.

866. Penetration Tests and Bearing Capacity of Cohesionless Soils, by G. G. Meyerhof. (SM) From a comparison between standard (dynamic) and static penetration resistances, a simple approximate correlation has been obtained for estimating the relative density and angle of internal friction of cohesionless soils. The proposed relationships are applied to determine the ultimate bearing capacity of footings and the point resistance and skin friction of piles, and the results are compared with some field loading tests on plates and piles.

867. Triaxial Shear Tests on Pervious Gravelly Soils, by Wesley G. Holtz and Harold J. Gibbs. (SM) This paper concerns a study of shear characteristics of pervious gravelly soils commonly used in earth embankments. Large-size triaxial

equipment was used for tests providing information on the relations of shear and (1) density, (2) amount of gravel, (3) gradation, (4) particle size, and (5) particle shape.

868. Analysis of a Skew Diversion, by Wen-Hsiung Li. (HW) When a roadway intersects a relatively straight and stable stream at an acute angle, a common method of diversion involves a skew culvert with or without reduction of skew. When the culvert is put at a reduced skew, a ditch parallel to the roadway is often used. By the principles of engineering economics, the most economical location of skew culverts can be obtained, taking into account the relevant economic, hydraulic, and topographical factors. The result of this analysis shows the relative importance of these factors; it can be used as a guide to the economical design of skew diversions.

869. A Direct Method for Model Analysis, by Norbert E. Lehddeck. (ST) A structural model cut from a flat sheet of plastic is combined with SR-4 resistance-type strain gages to offer a rapid solution of a statically indeterminate frame problem. The method of experimental stress analysis is described; it is considered practical for structural design problems involving short heavy members, frame members in which there are sudden changes in the depth of beams, or for the design of highly indeterminate structures.

870. On the Deflections of Bow Girders of Non-Circular Shapes, by Enrico Volterra. (EM) Deflections of bow girders of non-circular shapes built-in at both ends are studied. Solutions are given in explicit form for cases in which the central line of the curved beam is a cycloid, a catenary, or a parabola and the external forces are uniformly distributed along the length of the beam. Curves of the deflections, angles of twist, and bending and twisting moments are presented and compared with the corresponding values for the circular bow girder.

871. Control of Highway Access: Experiences in New York, by B. D. Tallamy. (HW) Experience with the New York Thruway has shown how limited-access high-

ways foster safety, save travel time, reduce wear and tear on vehicles and drivers, relieve traffic on parallel roads, and promote astounding economic development of the area. More superhighways are needed across the nation; the immediate problem is how to finance them.

872. Control of Highway Access: Economic Effects of the Gulf Freeway, by D. C. Greer. (HW) This paper reviews some of the conclusions drawn from investigations of the economic effects of limited-access facilities on adjacent properties and presents a detailed account of the method of approach and conclusions of an economic survey of a freeway in Texas. The increase in land values of adjacent properties after a period of five years is evaluated.

873. Control of Highway Access: Experiences in Indiana, by Carl E. Vogelgesang. (HW) This paper covers the experience leading to the adoption and use of control of access in Indiana. There are described the measures taken in an effort to handle traffic satisfactorily on the state highway system through the construction of by-passes and dual lane pavements. High points of the legislative acts are quoted, and the benefits of controlled access are enumerated as well as the conclusions reached.

874. Control of Highway Access: Experiences in Los Angeles, by Hugo H. Winter. (HW) This paper examines briefly the history of the freeway system in the Los Angeles metropolitan area, the accomplishments in construction of the units of the system, the direct and indirect benefits already derived from the completed units, and the benefits to be obtained from a completed integrated system of freeways.

875. Control of Highway Access: User Benefits in California, by Ralph A. Moyer. (HW) An analysis is given of the user benefits resulting from the early completion of the freeways with full control of access in California. The analysis is an important consideration in determining the economic justification of the system. It is shown that estimated user benefits in the first ten years

amounted to \$1 billion, which is an amount greater than the total interest for thirty years on the investment, and over a thirty-year period the estimated benefits are almost \$8 billion—more than double the total interest and principal required to finance the system.

876. Discussion of Proceedings Papers 604, 674, 818. (EM) D. Ross closure to 604. H. J. Cowan on, and B. Bresler and K. S. Pister closure to, 674. Corrections to 818.

877. Discussion of Proceedings Papers 500, 596, 783. (HW) No closure to 500. J. H. Moore closure to 596. G. H. Matthes, E. W. Lane, and C. F. Izzard and J. N. Bradley on 783.

878. Discussion of Proceedings Papers 588, 734, 762, 763, 764, 786, 809, 828. (ST) R. B. B. Moorman closure to 588. J. J. Polivka on 734. J. J. Polivka on 762. J. J. Polivka on 763. J. R. Benjamin on 764. E. G. Peterson, M. A. Roose, H. P. Budgen on 786. J. R. Benjamin on 809. G. V. Berg on 828.

February

879. Planned Industrial Districts, by Victor Roterus. (CP) Planned industrial districts, like planned residential districts, are subdivided and developed under definite plans and controls. The paper describes the advantages of planning to industry and the neighboring residential communities, including possible economies in public utilities and other public services.

880. Design of Stable Canals and Channels in Erodible Material, by Pete W. Terrell and Whitney M. Borland. (EX) This paper covers major factors which must be integrated into the design of a canal and outlines present methods of canal design. Several methods for computing the proper size and shape of channels are suggested, and an example is presented. Practical considerations and field experience related to stability problems are cited.

881. Discussion of Proceedings Papers 489, 536, 667, 678, 716, 744, 745, 747, 791, 882. (HY) E. L. Hendricks closure to 489. V. T. Chow closure to 536. T. Blench closure to 667. F. Paderi on 678. W. D. Baines on 716. W. H. Sammons on 744. E. Kuiper, W. H. R. Nimmo on 745. A. Shukry, J. M. Robertson, E. F. Rice on 747. A. J. Peterka and J. N. Bradley on 791. H. A. Foster on 882.

882. Economic Aspects of Flood Plain Zoning, by H. W. Adams. (HY) The zoning of flood-plain lands for the alleviation of flood damages has not been extensively used as a primary means of damage prevention. The economic aspects of zoning cited in the paper make it essentially an alternative to evacuation or to prevention.

883. Evaluating Effects of Land-Use Changes on Sediment Load, by Alfred J. Cooper and Willard M. Snyder. (HY) The effects of land-use changes on the suspended sediment load characteristics of tributary watersheds are evaluated by multiple regression analysis. Time-regression functions representing the effects of changing vegetal cover and the hydrologic parameters in the models are tested for significance in adjustment of the data.

884. Methods of Determining Consumptive Use of Water in Irrigation, by R. D. Goodrich. (IR) Attention is called to early investigations of the "duty of water" in irrigation and to "consumptive use of water" or "evapo-transpiration." Standard methods of determination of rates of consumptive use are outlined, and the utilization of their results in measuring farm and valley uses is described.

885. Sanitary Engineering Programs of the I.C.A. in the N.E.A. Area, by Vincent B. Lamoureux. (SA) General sanitation problems relevant to the program of the International Cooperation Administration in the Africa, Near East, and South Africa area are described, and the problems of the individual countries are examined.

886. Industry Location Factors, by Jerome P. Pickard. (CP) Improved transportation has affected various locational

factors so that there is now greater freedom of locational choice, which leads to the dispersion of industry. Locational factors are considered, and differences between industries located in suburbs and those within cities are described. An example is given.

887. Pilot Plant Composting of Municipal Garbage at San Diego, California: Progress Report of the Sanitary Engineering Research Committee, Rubbish and Garbage Section. (SA) The paper evaluates results of a pilot plant investigation of the feasibility of composting municipal garbage in which various methods of composting tried were including the use of additives and grinding.

888. Variation of Point Rainfall with Distance: Progress Report of the Sanitary Engineering Research Committee, Water Section. (SA) The variation of point rainfall with distance was studied using data from a 50-gage network within a 100-sq-mile area in central Illinois. It was found that the regression system is most practical for prediction purposes.

889. Effect of Air Conditioning on Distribution and Pumping Stations, by C. Kelsey Mathews. (SA) The effect of air conditioning on the design of water distribution systems—distinct from its effect of treatment plants—is presented. Comparative measurements indicate an excessive investment in the distribution system if nonconserved air conditioning is not prohibited.

890. Recovery of Usable Water from Saline Water, by David B. Smith and Charles E. Richheimer. (SA) Future water demands require that all sources of water be used. One potential source of water is in the vast quantities of saline water. Various methods for recovery of usable water from saline waters are discussed, and the economics of each process is developed.

891. Pollution of Los Angeles and Long Beach Harbors, by Linne C. Larson. (SA) After a factual survey and investigation of the disposal of sewage and industrial wastes in

harbors, long-range waste disposal and water quality objectives were formulated and adopted for Los Angeles-Long Beach Harbors. The objectives and the results obtained are described.

892. Planning Sewerage Services for Suburban Areas, by Ray E. Lawrence. (SA) Some of the problems of providing sewerage services for suburban areas can be avoided by careful advance planning. Joint use of trunk sewers and sewage treatment facilities by districts and municipalities should be considered. Examples of the stage development of a sewerage system on the basis of drainage area are cited.

893. Transportation Planning: The Port—A Focal Point, by Roger H. Gilman. (CP) The port has become a focal point for every form of transportation, not only by water but by land and increasingly by air. The paper points out that attention must be given to present and future trends of all forms of transportation and to integration, coordination, and cooperation among the public agencies and private interests concerned.

894. Transportation Planning: The Airport, a National Facility, Wilfred M. Post, Jr. (CP) This paper describes how a medium-size trunk-line airport has been developed, financed, and is being operated under a local airport authority. The legal and economic history of an airport is traced, including the creation of the airport authority after World War II. The operations and financing of the airport are further considered.

895. Fish Passage Facilities at McNary Dam, by Glenn H. Von Gunten, Hugh A. Smith, Jr., and Berton M. Maclean. (PO) Fish-passing facilities represent a major item in the operation and maintenance cost at McNary Dam. This paper provides a description of fish-passing facilities, a discussion of the functional design, a résumé of construction and operation problems, and a discussion of possibilities for further improvements in design.

896. Trombay Power Station: Cooling Water System, by William Wallace and George E. Archibald. (PO) Large steel

pipes carrying cooling water are supported above high water in Bombay Harbor. A pipe-supporting concrete trestle has piles grouted into sockets in the rock floor of the harbor. Pipe anchorage is varied to accommodate conditions of support.

897. Water Resources and Power Studies, Task Force, Hoover Commission: Organization and Scope; Conclusions and Recommendations, by Ben Moreell. (PO) The basic organization of the task force and the scope and objectives of the studies undertaken by it are presented. The author's conclusions and recommendations, based on the contents of the final report, are offered.

898. Water Resources and Power Studies, Task Force, Hoover Commission: Power Generation and Distribution, by John Jirgal. (PO) The federal government's largest and most rapidly expanding business venture is the generation and sale of electric power. In 1933 the federal government owned less than 1% of the total utility plant capacity in the United States and by 1953, 12½%. By 1960 it will be about 16%.

899. Water Resources and Power Studies, Task Force, Hoover Commission: Reclamation and Water Supply, by Leslie A. Miller. (PO) This paper stresses the necessity of conserving water supplies and using water to the utmost advantage. The functions of various federal agencies overlap, with no guiding national policy. Recommendations are made for a uniform policy as to the financing of projects in relation to beneficiaries and local, state, and federal governments.

900. Water Resources and Power Studies, Task Force, Hoover Commission: Flood Control, by W. W. Horner. (PO) This paper reviews the number and cost of presently constructed and probable future flood-control projects. An estimated 5.8% of the cost of projects completed was paid by local beneficiaries and the remainder by federal taxpayers. Another flaw in the program is the nonuniform method of calculating benefits of projects.

901. Water Resources and Power Studies, Task Force, Hoover Commission: Improvements to Navigation, by Carey H. Brown. (PO) This paper concludes that many navigational improvements now under consideration or recommended are of dubious economic value. Development of economically sound projects could be implemented by making user charges adequate at least for maintaining and operating navigation systems.

902. Discussion of Proceedings Papers 241, 424, 458, 720. (AT) No closure to 241. W. J. Turnbull and O. B. Ray closure to 424. G. S. Anderson, and G. McFadden closure to 458. R. H. Williams, J. F. Redus on 720.

903. Discussion of Proceedings Papers 461, 462, 705, 706, 708, 728, 788. (IR) H. M. Ismail closure to 461. No closure to 462. H. E. Thomas, C. E. Busby, P. H. Berg, J. C. Alexander on 705. H. E. Thomas, F. B. Clendenen on 706. Correction to 708. D. C. Muckel, C. C. Warnick, N. Szalay, C. W. Lauritzen on 728. W. M. Borland and C. R. Miller, and S. Leliavsky on 788.

904. Discussion of Proceedings Papers 696, 697, 700, 737, 739, 741, 742. (PO) M. D. Copen, A. W. Simonds, J. T. Richardson, A. C. Xerez on 696. R. F. Krafft on 697. J. L. Serafim on 700. G. B. Woodruff, J. Feld, W. W. Moore, G. L. Jordy on 737. R. N. Brudenell on 739. E. W. Vaughan, S. N. Nicolaou, W. R. Martin, Jr., and J. A. Veltrop, and M. L. Pei on 741. A. Hrennikoff, J. L. Serafim, S. Leliavsky on 742.

905. Discussion of Proceedings Papers 591, 685, 687. (SA) No closure to 591. T. R. Camp closure to 685. J. E. McKee on 687.

March

906. Old River Diversion Control: The General Problem, by John R. Hardin. (WW) The history of major Mississippi River diversions is presented, the development of the problem of the diversion of the

Mississippi River flow through Old River and the Atchafalaya River is traced, and an analysis is made of the observations and studies leading to the conclusion that diversion of the Mississippi River through the Atchafalaya River is imminent.

907. Old River Diversion Control: Hydraulic Requirements, by E. A. Graves. (WW) The streams and floodways of the area form a complex system. Observed and planned discharges illustrate the magnitudes involved. The control of Old River has become necessary because of the threat that the Mississippi River will adopt the course of the Atchafalaya River. An unusual situation exists with respect to the determination of prevailing and prospective tailwater conditions. The expected discharges through the structures are compared with natural flows.

908. Old River Diversion Control: Foundation Design, by W. J. Turnbull and W. G. Shockley. (WW) General geology and soils conditions are presented for the low-sill, overburden control and navigation lock structure proposed for the diversion control of Old River. A detailed description of soil properties and foundation conditions is given for the low-sill structure. Important foundation design features of this structure are discussed.

909. Old River Diversion Control: Structures Required, by Norman R. Moore. (WW) Positive control of Mississippi River flow diversion into the Atchafalaya Basin through Old River requires provision of structures permitting retention of the adopted flood control plan. A lock must also be provided to meet navigation requirements. Planning and design of the structures and appurtenances are described.

910. The Design Wave in Shallow Water, by R. L. Wiegel and K. E. Beebe. (WW) A discussion is presented of the prediction of forces exerted by ocean waves on piles where the wave height is limited by the depth of water (a breaker). Laboratory data are presented which show that a modified solitary wave theory predicts the velocity profile under the crest of a breaker with a standard deviation of 27%.

911. A Ripple Tank Study of Wave Refraction, by G. C. Ralls, Jr. (WW) Refraction of uniform waves on a beach of constant slope was studied in a ripple tank and found to verify Snell's law for wave refraction. The law was verified in this study by analyzing photographic records of wave refraction on a model beach. Both the beach slope and the angle of orientation of the wave train were varied in the investigation.

912. Destruction of Wave Energy by Vertical Walls, by Per Bruun. (WW) Wave energy can be destroyed or affected in different ways by: diffraction, refraction, reflection, breaking, resonance, friction, permeability, special hydraulic arrangements as stilling basins and berms, and by air entrainment. In the paper a summary is given of different methods of destroying or affecting wave energy.

913. Discussion of Proceedings Papers 503, 611, 612, 727, 801, 803. (WW) C. Renshaw closure to 503. N. Chien closure to 611. G. H. Matthes closure to 612. Z. Levinton on 727. G. M. Allen, Jr., on 801. E. Kuiper on 803.

914. Influence Lines for Reactions of Continuous Trusses, by Andrew John Pyka. (ST) The writer, in his experience in bridge design, has sought simplifications in the various methods of obtaining influence lines for reactions of continuous trusses. A procedure known as the "Analogous Cantilevered Truss Method" has been developed which embraces the principles of internal and external work as produced by a one-pound load applied at the end of the structure after all reactions are removed and the truss is cantilevered from a wall support. As a result of a simplified design procedure, computational errors are easily detected and corrected.

915. Arching Action Theory of Masonry Walls, by E. L. McDowell, K. E. McKee, and E. Sevin. (ST) The arching action theory of masonry walls proposed in this paper represents a radical departure from the resistance to lateral forces usually assumed for this type of construction. The proposed theory is offered as one means of explaining and predicting the relatively great

strength of masonry walls constrained between essentially rigid supports. Comparison is made with the available test data on lateral loading of brick beams.

916. Analysis of Collar Slabs for Shells of Revolution, by Gunhard Oravas. (ST) Shells of revolution find wide application as surface carrying structures spanning large unobstructed areas with considerable weight-strength economy of the structure. Very often these shells are extended beyond their boundaries by rotationally symmetrical collar slabs. A typical structure of this kind is analyzed in this paper by a method of successive approximations.

917. Heavy and Tall Building Problems in Mexico City by Leonardo Zeevaert. (ST) Heavy and tall buildings in Mexico City create special problems in foundation engineering and structural design because of the difficult subsoil conditions and earthquakes. This paper cites the problems that arise in the design of the foundation for heavy and tall building in Mexico City and in order to illustrate the general philosophy of design, at the end of the paper two specific cases of foundations designed by the author for two important buildings in Mexico City are presented.

918. Effects of Nuclear Reactor Radiations on Structural Materials, by Ira F. Zartman. (ST) The different types of the nuclear radiations to which materials used in the construction of nuclear reactors are exposed is discussed. Conditions imposed by functional requirements are considered. The effects of nuclear radiations on the mechanical and physical properties of structural materials, experimental results, and basic effects are considered.

919. Behavior of Shock Waves Entering Model Bomb Shelters, by B. B. Dunne and Benedict Cassen. (ST) The use of a spark shadowgraph with effective exposure time of a fraction of a microsecond has enabled very sharp pictures to be obtained of the time sequence of shock wave advance, reflection, diffraction, and turbulent breakup in models placed in a 4 × 4 inch square cross section shock tube. The equipment

has been used to gain considerable information on the penetration of shock waves into model shelters. The production and behavior of strong vortices in the models indicate that they should be considered as a full-scale factor in effects on personnel.

920. Tests on Bolted Connections in Light Gage Steel, by George Winter. (ST) Results are summarized of 574 tests on bolted connections in light-gage steel, covering considerable ranges of the pertinent variables such as bolt diameter, sheet thickness, mechanical properties of sheet and bolt steels, edge distance, etc. Four conditions are formulated for predicting failure loads which are in satisfactory agreement with test values. It is shown that if an adequate safety factor is applied to these four conditions, joint deformations at design loads can be held to reasonably small values.

921. Professional Aspects of Surveying and Mapping: Report of the Task Committee on the Status of Surveying and Mapping. (SU) This paper is a report on the professional status of persons engaged in surveying and mapping. Included is a chart of the six surveying and mapping categories, in which the operations are classified as to whether they be professional, pre-professional, or technician level. This is the first phase of a continuing study by a Task Committee on the status of surveying and mapping.

922. Progress in Topographic Mapping from 1946 to 1955, by Gerald FitzGerald. (SU) Scientific and engineering research applied to the procedures for constructing topographic maps since World War II has resulted in the development of new instruments, new photogrammetric equipment and more efficient production methods and techniques. In this period, the cost of mapping has been greatly reduced and with the increased funds available, the output of topographic quadrangle maps has increased about seven times. Although only 37% of the United States is adequately mapped at the present time, at the current rate complete topographic quadrangle map coverage of the country could be accomplished in approximately 17 years at a cost of about \$220,000,000.

923. Surveying and Mapping for the Air Force Academy, by Edward A. Merrill. (SU) The problem of master planning and design of a major installation on a complicated site must be based on adequate knowledge of the topography. A description of the procedures utilized with illustrations showing the site, the characteristics of which influenced these procedures, and typical maps developed for use.

924. Discussion of Proceedings Papers 539, 560, 649, 659, 680, 684, 733, 763, 764, 809, 825. (ST) H. C. S. Thom closure to 539. A. F. Diwan closure to 560. W. E. Hanson and W. F. Wiley closure to 649. J. R. Fuller closure to 659. R. Schjodt closure to 680. A. E. Komendant closure to 684. No closure to 733. W. Weleff on 763. I. Z. Sobotka on 764. I. Martin. Associacao Brasileira de Cimento Portland, H. G. Lorsch, L. A. North, and C. F. Long on 809. Corrections to 825.

April

925. Wave Run-Up on Shore Structures, by Thorndike Saville, Jr. (WW) The run-up of waves on shore protection structures has been studied by the Beach Erosion Board. The author describes the tests used to determine the run-up related to wave steepness, structure type, and depth of water.

926. Houston, Texas, Floodway, by Kenneth Heagy. (WW) The most suitable flood protection plan for Houston provides for the continued operation of the Barker and Addicks Reservoirs, and for the clearing, strengthening, enlarging, and lining of the Buffalo, Brays, and White Oak Bayous.

927. Trinity River Flood Control Project, by James A. Cotton and W. E. Wood. (WW) A Federal project of four reservoirs and two floodway improvements on the Upper Trinity River, Texas, is described. This project gives protection to agricultural lands and to the urban areas of Fort Worth and Dallas.

928. Design of Venturi Flumes in Circular Conduits, by Edwin A. Wells and Harold B. Gotaas. (SA) The coefficient of discharge for Venturi flumes and the hydraulic

aspects of Venturi flow are discussed. The experimental studies and results show the influence of various flume dimensions.

929. Intermittent Discharge of Spent Sulfite Liquor, by Herman R. Amberg and Robert Elder. (SA) Intermittent discharge of spent sulfite liquors into the Columbia River is proposed to control slime growth, which can be controlled if the wastes are discharged intermittently into a river of sufficient volume and high velocity.

930. The Analysis of Water Samples for Cyclical Variations, by Alex N. Diachishin. (SA) The tidal variation of bacterial populations is examined from a mathematical standpoint. The statistical variation of samples collected during one tidal cycle is compared to the theoretical variation of the M.P.N. test.

931. Water Supply in Arctic Areas: Design Features, by Lloyd K. Clark and Amos J. Alter. (SA) Long sub-zero winters and permanently frozen ground impose restrictions in the design of Arctic water systems. Design features are suggested for water source, treatment, distribution, and storage.

932. Discussion of Proceedings Papers 592, 686, 687. (SA) D. R. Stanley closure to 592. W. J. Oswald and H. B. Gotaas closure to 686. C. N. H. Fischerstrom closure to 687.

933. New Test for Control of Cohesive Soils in Rolled-Fill, by J. MacNeil Turnbull. (SM) The "drop" test controls the placing of rolled-fill under modern rapid rates of construction. One test supplies the optimum wet density and the difference between field and optimum moisture.

934. Stabilization of Materials by Compaction, by W. J. Turnbull and Charles R. Foster. (SM) This paper shows, for cohesive soils, how strength varies with water content and density and how variations in rolling and lift thickness affect the density and strength obtained in field compaction.

935. Bridge Clearances: Policies and Practice, by Eugene W. Weber. (WW) Highway transport, the resurgence of waterways traffic, and the continued develop-

ment of railroads have resulted in radical changes in the bridge clearance problem. Its history and the steps necessary for its solution are developed.

936. Bridge Clearances: The Interest of the Bureau of Public Roads, by Walter Kurylo. (WW) A new concept of national transportation policy concerning bridge clearances for navigational needs is being developed. It protects the public interest rather than one form of transportation.

937. Bridge Clearances: Problem Needs Realistic Approach, by William E. Cleary. (WW) The need exists for a practical approach to bridge clearances. An agreement has been reached between navigational and other interests relative to clearances along the Connecticut Expressway.

938. Bridge Clearances: The Operator's View, by N. L. Caruthers. (WW) Marine interests have become increasingly aware of the problem of bridge clearances across navigable waterways. The thesis is developed that each crossing should be considered on its own merits.

939. Bridge Clearances: Problems in Northeastern United States, by E. E. Dittbrenner. (WW) This paper cites examples in northeastern United States where coordination between highway and waterway has been and can be beneficial and relates conditions here to those in the rest of the United States.

940. Thrust Loading on Piles, by James F. McNulty. (SM) Lateral load tests were performed on two separate projects for the National Advisory Committee for Aeronautics, Langley Field, Virginia. The field data and an approximate method of analysis are presented and discussed.

941. Earthquake Resistance of Rock-Fill Dams, by Ray W. Clough and David Pirtz. (SM) An experimental investigation of the effects of earthquakes on rock-fill dams with earthen cores is described. Results show these dams are resistant to earthquakes because of their flexible structure.

942. Discussion of Proceedings Papers 548, 756, 757. (SM) T. F. Thompson closure to 548. No closure to 756. S. Leliavsky on 757.

943. Inelastic Buckling of Non-Uniform Columns, by John E. Goldberg, John L. Bogdanoff, and Hsu Lo. (EM) A numerical procedure is presented for calculating the critical loads of non-uniform, pin-ended columns in the elastic or inelastic range.

944. The Dynamic Response of Tall Structures to Lateral Loads, by L. Schenker. (EM) Some aspects are considered of the analytical procedures for computing the response of structures to dynamic forces. Only tall structures subjected to lateral forces or displacements are considered.

945. The Viscous Sublayer along a Smooth Boundary, by H. A. Einstein and Huon Li. (EM) If the sublayer is visualized as a steady, quasi-laminar flow, difficulty is encountered in the physical description of the transition to the turbulent part of the flow. The proposed model visualizes a periodic growth and decay of the sublayer.

946. Discussion of Proceedings Papers 670, 671, 695, 817, 818. (ST) T. E. Stelson and F. T. Mavis closure to 670. J. H. Weiner, M. G. Salvadori, and V. Paschakis closure to 671. B. G. Johnston and A. Mathews closure to 695. R. E. Glover, V. E. Hansen, J. N. Luthin, C. S. Yih on 817. H. G. Lorsch on 818.

947. Report on Experiences with Water Wheel Unit Alignment, by S. O. Schamberger. (PO) In this paper an attempt has been made to collect and correlate some of the proven cases of water-wheel misalignment experienced after original erection, to study the causes of this behavior, to note the methods used in correcting them, and to suggest a method for checking a misalignment condition.

948. Hydraulic Design of the Sandow Pumping Plant, by R. T. Richards, E. T. Keck, and J. Junget. (PO) There is described the hydraulic design of the Sandow Pumping Plant which combines large vertical pumps, long and irregular pipeline profiles, and surge and flow control problems.

949. Steel Lining for Pressure Shafts in Solid Rock, by E. W. Vaughan. (PO) The methods used in the design of two pressure shafts in Brazil are discussed in detail

and their general features compared with those of other shafts constructed elsewhere; pertinent details of design and construction are presented.

950. Project Construction at McNary Dam, by S. G. Neff and J. J. Morton. (PO) This paper discusses the project construction which will include the general requirements, the general plan of construction, the construction operations, and some of the special construction features and problems.

951. McNary Dam—Coordination of Project Design and Construction, by Otto R. Lunn. (PO) On large, multi-purpose dams like McNary on the Columbia River, the design of the dam structures must of necessity be closely coordinated with construction.

952. Discussion of Proceedings Papers 700, 948. (PO) S. Leliavsky on 700. S. L. Kerr on 948.

953. Research Needs in Sediment Hydraulics, by Enos J. Carlson and Carl R. Miller. (HY) The tools available for solution of sediment problems encountered by the Bureau of Reclamation are discussed and the areas where research and development are needed to improve these tools are given.

954. Flood Plain Zoning as Supplement to Flood Control, by Emil P. Schuleen. (HY) Factors affecting flood plain development are considered and the limitations and ineffectiveness of various types of flood control measures are described. The need for flood plain zoning to control such development is presented.

955. Discussion of Proceedings Papers 745, 806, 826, 836, 838, 840. (HY) S. C. Happ on 745. N. H. Brooks, F. L. Hotes, J. A. Harder, C. H. Lee, R. T. Knapp on 806. R. D. Goodrich, C. F. Merriam and E. T. Schuleen, W. M. Snyder on 826. F. C. Craig, and L. J. Tison on 836. C. J. Keifer and H. H. Chu, R. Y. D. Chun, M. Hom-Ma, A. Newman, S. Kolupaila on, and corrections to, 838. D. M. Hershfield and W. T. Wilson on 840.

956. Geology of Some American Estuarine Harbors, by Parker D. Trask. (HY) The formation of numerous harbors in the United States are described. Most of these harbors show the effects of differential erosion.

957. Use of Zoning Principles in Flood Plain Regulation, by Joseph I. Ferrey. (HY) Zoning ordinances for the protection of the water-carrying capacity of floodways should prohibit all construction that may reduce the floodway cross section or otherwise limit the capacity of the floodway.

958. Sewage Disposal in Sweden, by James Garner. (HY) Stockholm is faced with the problem of disposal of more sewage than can be handled with the present facilities. Increasing the sewerage systems has resulted in several engineering problems and solutions.

959. The Philosophy of Arch Dams, by Andre Coyne. (PO) This paper discusses the reasons for the inherent strength of arch dams, the evolution of basic criteria and arch dam shapes, and briefly touches on the economics, calculation of stresses, and the value of structural models.

960. Trial Load Studies for Hungry Horse Dam, by R. E. Glover and Merlin D. Copen. (PO) A brief history is given of the development of the Trial Load method for stress analysis of arch dams and the application of these procedures to the design of the Hungry Horse Dam is described in detail.

May

961. Cost Allocation for Multi-Purpose Water Projects, by N. B. Bennett, Jr. (IR) The Separable Cost-Remaining Benefits method of cost allocation, its dependence on benefits and alternate costs, and the meanings attached to single-purpose alternate costs, specific and separable costs, joint costs, and remaining project costs are discussed.

962. Design of Major Drainage Canals, by E. W. Eden, Jr. (IR) This paper is chiefly concerned with areas in which the only practical measure for the control of

floods is the improvement and enlargement of existing outlets or by the diversion of excess water to some alternative, more economical, outlet.

963. Design of the Modern Industrial Plant, by E. X. Tuttle. (CP) Dominating the trends in industrial plant design are the conditions and extent of human toil and flexibility. Planners and architects must assure reduction in work load and flexibility of industrial facilities while protecting the investments of individuals, industries, and the community.

964. Urban Redevelopment Can Implement Mass Transit, by W. H. Claire. (CP) Sharing the high first cost of installation of modern profitable rapid mass transit facilities is feasible through the redevelopment of areas in the vicinity of the transit facility. Part of the tax revenue increase from these areas is used to encourage the development of the transit facility.

965. Developing Port Facilities on Houston's Ship Channel, by F. H. Newnam, Jr. (WW) Studies were made to determine the best layout for development of wharves on a new tract on the Houston Ship Channel. Particular attention was given to the comparative advantages of marginal type wharves or finger piers.

966. Flood Protection at Wichita and Valley Center, Kan., by M. W. De Geer. (WW) The flood problem at Wichita, Kan., is discussed, as well as the design of a system of floodways and levees for the protection of the city and its environs. The project structures and the status of construction scheduled for completion in 1958 are also described.

967. Improving the Gulf Intracoastal Canal in Texas, by W. P. McCrone. (WW) Because of increased traffic, the users of the Gulf Intracoastal Canal requested that its size be increased from New Orleans, La., to Brownsville, Tex. The studies and analyses made to determine the extent of the justified enlargement are discussed.

968. Design Problems Involved in Protection from Tsunamis, by K. Kaplan. (WW) Laboratory studies of Tsunami

(earthquake-generated) type water waves were made to assess the importance of various wave parameters in the design of protective structures along shorelines. Relationships between the dimensionless parameter wave height, wave length, and wave run-up on both beach slopes and seawall faces were developed.

969. New Locks on Lower Mississippi and Gulf Coast, by N. R. Moore. (WW) This paper concerns the principal navigation locks constructed since World War II and those scheduled for construction in the near future. The diverse requirements governing the design and some unusual construction problems are described.

970. Specifications for Structures of Aluminum Alloy 6061-T6: Second Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys. (ST) These specifications cover allowable stresses, design rules, and fabrication procedures for structures built of the aluminum alloy known commercially as 6061-T6 (formerly 61S-T6).

971. Specifications for Structures of Aluminum Alloy 2014-T6: Third Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys. (ST) These specifications cover allowable stresses, design rules, and fabrication procedures for riveted heavy-duty structures built of the high-strength aluminum alloy known commercially as 2014-T6 (formerly 14S-T6).

972. Discussion of Proceedings Papers 561, 586, 652, 734, 763, 809, 825, 828, 829, 830, 851. (ST) K. V. Taylor closure to 561. J. D. Griffiths closure to 586. H. A. Miklofsky closure to 652. Corrections to B. C. F. Wei in 879 on 734. E. Giangreco on 763. P. W. Abeles, and L. W. Mensch on 809. A. W. Hainlin, and T. C. Rathbone on 825. E. N. W. Lane, and A. C. Scordelis on 828. C. L. Chang, and H. A. Sawyer on 829. E. G. Stern, and N. B. Jones on 830. B. G. Johnston on 851.

973. Dynamic Stresses in Continuous Plate Girder Bridges, by R. C. Edgerton and G. W. Beecroft. (ST) Results are presented of tests conducted by the Bureau of Public Roads and the Oregon State Highway

Department on two three-span continuous plate girder bridges in Oregon. The test records provide values of frequency of vibration, amplitude of vibration, and amplitude of strain oscillation.

974. Earthquake Stresses in Spherical Domes and in Cones, by E. P. Popov. (ST) Formulas for the primary or membrane stresses in spherical domes and cones due to earthquake loading are given. It is shown how the ordinary flexure formula may be used directly in determining the meridional membrane stresses.

975. Control of Rio Grande by United States and Mexico, by J. C. Bustamante and J. F. Friedkin. (WW) Since the Rio Grande was established as a boundary between the United States and Mexico, the problems of channel realinement, flood control, irrigation, and power development have been dealt with successfully by a joint commission.

976. Sand By-Passing at a Virginia Tidal Inlet, by T. J. McDonald and M. A. Sturgeon. (WW) The paper describes the sand barrier effect of a nearby tidal inlet on the beach erosion problem at Virginia Beach, Va., and sets forth criteria for the design of a sand by-passing system to compensate for this effect.

977. Economic Criteria for Water Development Projects, by J. J. Rasmussen. (IR) Water development projects must be planned and their feasibility evaluated in terms of national objectives with due consideration given to all the various facets of a project. Certain specific economic criteria must be considered.

978. The Effect of Airport Distance on Traffic Generation, by J. C. Buckley. (AT) Before a choice is made between a distant and a close-in location for a municipal airline airport, the effect of airport distance on air traffic generation and the resultant financial effects should be evaluated.

979. The Design of Non-Rigid Overlays for Concrete Airfield Pavements, by F. M. Mellinger and J. P. Sale. (AT) The part played by the Corps of Engineers' (United States Department of the Army) Pavement

Investigational Program pertaining to the development of design criteria for non-rigid overlays of concrete airfield pavements is summarized.

980. What is the Story of Aviation Today? by J. D. Blatt. (AT) From historical data, trends in the design of air transportation facilities are established and air transportation forecasts are made. 1960 and 1965 forecasts of airline passengers, air cargo, general aviation, low visibility operation, and international and overseas air commerce are discussed.

981. Benefits of Water Development Projects, by E. R. Fogarty. (IR) The extent to which uniform procedures for analyses of benefits and costs by water development agencies can be meaningful is limited by different legislative requirements, project purposes, and types of projects.

982. Discussion of Proceedings Paper 788. (IR) M. L. Albertson and H. K. Liu on 788.

983. Highway Engineering Manpower—Recruiting and Training of Graduates, by R. Winfrey. (HW) There are two sources of recruitment for filling the need for highway engineers—high school graduates and college civil engineering graduates. Highway departments should give more attention to the selection and training of employees than to equipment and materials.

984. Highway Engineering Manpower: Engineering Education Aspects, by H. E. Davis. (HW) Those factors which relate to education and training and which have a bearing on the highway manpower problem are summarized. Improved procedures and the increased use of engineering technicians can avoid a crisis caused by the increased output from highway agencies.

985. Discussion of Proceedings Papers 703, 783, 824, 868. (HW) C. C. Wiley, and A. H. Brownfield on, and P. Hartman closure to, 703. C. E. Kindsvater, and P. R. Neeley on 783. P. H. Calahan, F. W. Holden, and R. H. Griffiths on 824. Corrections to 868.

986. Limit Design for Buildings, by B. C. Ringo. (ST) A comparison is drawn of limit design to elastic design methods as used with structural steel. Some of the advantages and inherent characteristics of a simplified application of the method of limit design are presented, as they apply to typical structural steel framing for multi-story buildings.

987. A Pattern of Interstation Airline Travel, by D. M. Belmont. (AT) An analysis is made of airline travel between large and medium hubs. It is suggested that, for stations more than 800 miles apart, the number of trips between any two stations depends primarily on the total traffic at each of them and the quality of service.

988. Transportation Planning: Prospects for Coordination, by B. W. Marsh. (CP) Coordination in transportation planning has been almost completely lacking. Solutions to the problems of transportation conditions in the metropolitan areas can only be arrived at by cooperation among municipal agencies and civic and planning groups.

989. The New Federal-Aid Airport Program, by H. H. Howell. (AT) The author presents a review of the development of the air transport industry, its growth, its sociological implications, and the problems anticipated with the advent of jet transport aircraft. The development of federal assistance for airports is traced and the Programming Standards and Planning Standards of the Federal Airport Act of 1955 are given.

June

990. Arch Dams: Portuguese Experience with Overflow Arch Dams, by A. C. Xerez. (PO) An important part of every dam, affecting both safety and cost, is the arrangement by which flood waters bypass the dam. This paper cites Portuguese experience with arch dam spillways.

991. Arch Dams: Theory, Methods, and Details of Joint Grouting, by A. W. Simonds. (PO) This paper deals with the problems involved in the contraction joint grouting of arch dams. After briefly reviewing the history of joint grouting as prac-

ticed by the Bureau of Reclamation, the present-day practice is presented. An outline of the theory and procedure of contraction joint grouting is included.

992. Arch Dams: Santa Giustina Single-Curvature Arch Dam, by C. Marcello. (PO) The design and construction of an arch dam 152 meters high and located in an extremely narrow gorge is outlined. Briefly discussed is the structural analysis of the dam as confirmed by the model, the construction plant, and the extensive foundation consolidation and cut-off grouting.

993. Arch Dams: Measurements and Studies on Santa Giustina Dam, by C. Marcello. (PO) Because of the unusual proportions of this dam, special plans were made to study its behavior resulting from variations of water level and temperature. This paper is a preliminary report; it compares data obtained by four years of observation with data obtained by analysis.

994. Arch Dams: The Reno Di Lei Double-Curvature Arch Dam, by C. Marcello. (PO) The design of an arch dam by the trial-load method is presented. The center lines of the horizontal arches are shaped to coincide approximately with the funicular curves of the arch loads. Design is not yet complete and will be verified by model studies.

995. Arch Dams: Isolato Double-Curvature Arch Dam, by C. Marcello. (PO) The theoretical analysis, structural model testing, and construction plant of an unusual Italian arch dam are discussed. Data on the actual behavior of the dam for its two years of operation are included.

996. Arch Dams: Rio Freddo Dam with Gravity Abutments and Cut-offs, by C. Marcello. (PO) This paper outlines the design and construction of a double-curvature arch dam with gravity abutments and lateral cut-off wings. The instrumentation for determining the actual behavior of the dam is described.

997. Arch Dams: Design and Observation of Arch Dams in Portugal, by M. Rocha, J. L. Serafim, and A. F. da Silveira. (PO) Data are presented on design model testing

and field observation of six arch dams ranging in height from 60 to 135 meters. These data have enabled later designs to be modified to gain increased economy with safety.

998. The Federal Air Pollution Research Program, by A. C. Stern. (SA) The United States Public Health Service has been charged with the control of more than one-half million dollars for air pollution research during the present fiscal year. These funds are to be expended to nonfederal research agencies according to their potential contributions to this problem.

999. A New Approach to Trickling Filter Design, by W. T. Ingram. (SA) A new approach to trickling filter design has been made, based on a laboratory investigation over the period of a year. It has been possible to treat domestic sewage successfully at the same hydraulic rates used for rapid sand filtration of water.

1000. Waste Disposal as Related to Site Selection, by A. E. Gorman. (SA) The rapid increase in the atomic energy industry has produced many problems with regard to site selection. The paper discusses the waste disposal problems at various AEC installations and efforts made for their solution.

1001. Meteorology as Related to Reactor Site Selection, by F. D. White and D. H. Pack. (SA) The routine release of radioactive gaseous wastes as well as the possibility of an accidental release of large quantities of this waste material are discussed in relation to site selection. Some atmospheric diffusion formulas are presented to help assess the problem of site selection.

1002. Use of Soil Lysimeters in Waste Water Reclamation Studies, by G. T. Orlob and R. G. Butler. (SA) Current interest in waste water reclamation by surface spreading has dictated a need for further study of the mechanism of infiltration, the phenomena which determine the rates of water percolation, and the interaction of porous media and degraded waters.

1003. Discussion of Proceedings Papers 590, 773, 847, 885, 892. (SA) A. C.

Ingersoll, J. E. McKee, and N. H. Brooks closure to 590. R. E. McKinney on, J. C. Bumstead closure to, and A. D. Caster closure to 773. J. B. Rowntree on 847. A. Streiff on 885. G. W. Reid on 892.

1004. Visual Accumulation Tube for Size Analysis of Sands, by B. C. Colby and R. P. Christensen. (HY) A simple method is presented for analyzing sediments of sand sizes to obtain an accurate determination of fall-velocity distribution. Direct visual tracking of sediment accumulation produces a permanent continuous trace on a calibrated chart.

1005. Free-Surface Disturbances Along a Channel Wall, by A. M. Amein and M. S. Priest. (HY) An experimental study was made of the initiation and growth of free-surface disturbances along the wall of a steep channel. Results from analyses of experimental data are shown in both graphical and mathematical form.

1006. Transition Profiles in Non-Uniform Channels, by F. F. Escoffier. (HY) The concept of a transition profile as a theoretical tool for the study of water-surface profiles, particularly where these pass through critical depth without abrupt change, is developed. A practical method of constructing a transition profile graphically is outlined.

1007. Friction Measurements in Apalachia Tunnel, by R. A. Elder. (HY) This paper presents the results of tunnel friction measurements made on the TVA Apalachia power tunnel in 1944, five months after the initial filling, and again in 1954, five months after the first unwatering.

1008. The Use of Statistics in Reservoir Operations, by V. A. Koelzer. (HY) The development of annual operating plans for reservoir systems deriving their primary water supply from snowmelt, as well as progressive seasonal modifications to these plans, is demonstrated, with particular emphasis placed on the important part that probability analyses play in determining limits for the development of the operational plans.

1009. Free Outlets and Self-Priming Action of Culverts, by W. H. Li and C. C. Patterson. (HY) Data on the effective position of the hydraulic grade-line at the free outlet of full-flowing culverts are presented. Data on the conditions for self-priming of culverts with a sharp-cornered entrance are presented.

1010. Discussion of Proceedings Papers 678, 791, 836, 838. (HY) J. C. Stevens closure to 678. W. Rand closure to 791. J. A. Robertson on 836. R. Silvester, A. S. Harrison on 833.

1011. Discussion of Proceedings Papers 739, 741. (PO) G. Norwood on 739. D. J. Bleifuss closure to 741.

1012. Engineering Job Opportunities in World Health, by H. Engler. (SA) One of the major opportunities facing the sanitary engineer lies in environmental sanitation problems outside the United States. A general discussion of some of the co-operative programs is given.

1013. Advances in Sewerage in the Period from October 1, 1954, to December 1, 1955: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment. (SA) The recent advances in the design and construction of sewers and sewage pump stations are outlined and discussed.

1014. Investigation of Planned Refuse Collection and Disposal: SED Research Report No. 7, Sanitary Engineering Research Committee, Rubbish and Garbage Section. (SA) The results of seven years of investigation to develop a planned refuse disposal program for the Los Angeles County Sanitation Districts are summarized and critically evaluated.

1015. Proportional Weirs for Sedimentation Tanks, by J. C. Stevens. (HY) For grit channels or other types of sedimentation tanks it is desirable to control automatically the mean velocity through the tanks in order to obtain the most favorable conditions for settlement of the solids contained in the influent. This can be done by installing a properly formed weir in the outlet end of the tank.

1016. The 1954 Drought and Its Effect on Ground Water, by G. A. Mullenburg. (SA) Drought conditions prevalent in Missouri and neighboring areas from 1952 to 1954 reached a maximum in the summer of 1954. The cumulative deficiency from the two preceding years was 22.77 inches, and this was largely responsible for the disastrous conditions which marked 1954 as the worst in history.

1017. Arch Dams: Development in Italy, by C. Semenza. (PO) The reasons for extensive development of arch dams in Italy are listed and the historical stages of that development are traced. The methods of analysis are briefly reviewed and special features of construction procedure are given. The benefits of the peripheral point, which has been successfully used by the author, are explained.

1018. Arch Dams: Design of the Kamishiba Arch Dam, by C. C. Borin and H. W. Stuber. (PO) The first arch dam in the Far East, the Kamishiba Dam, was dedicated in 1955 as part of the 90,000-kilowatt-capacity Kamishiba Hydroelectric Development. This paper describes terrain, hydrologic conditions, foundation material, design assumptions, and methods of analysis pertaining to this project.

July

1019. Development and Design of the Walt Whitman Bridge, by Milton Brumer and C. W. Hanson. (ST) The historical development and design features of a major bridge project are presented, beginning with the point at which it becomes apparent that some type of new cross-river traffic facility must be provided. The numerous phases of study and the influences leading to the final selection of location and type of crossing are described. The Walt Whitman Bridge, a suspension bridge having a 2,000-ft center span, should be listed among the world's major bridges. The problems of design of the main foundations are discussed and the criteria for design of the superstructure are presented in detail. The new facility is scheduled to open for traffic early in 1957.

1020. Moments in Flat Slabs, by Mark W. Huggins and Watone L. Lin. (ST)

This paper summarizes the results of a study of moments in a cast-aluminum model of a flat slab floor. All panels were square and the columns and capitals were round. There were no drop panels. The model was two bays by three bays and was tested under air pressure with a pattern type loading. Moments obtained from SR-4 strain gage readings are compared with those obtained by continuous frame analysis following the American Concrete Institute Code (ACI-318-51).

1021. Bending Stresses in Edge Stiffened Domes, by Mario G. Salvadori and Robert Sherman. (ST) Bending moments and shears in certain types of thin shells of revolution stiffened by an edge beam are obtained, and graphs for their evaluation are given. Variable, symmetrical live and dead loads are considered, together with temperature and shrinkage stresses. Approximate but accurate values of the maximum moments in the shell and supporting cylinder are derived by means of the same graphs, when the dome is built-in into a cylinder and stiffened by an edge beam.

1022. Simplification of Design by Ultimate Strength Procedures, by Phil M. Ferguson. (ST) Based on the 1956 "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" and on the use of a rectangular stress block, design procedures for beams and columns are developed. Although the use of design charts is recommended, it is shown that most computations are simple and practical without such aids. Design procedures are; moreover, simpler than present working stress methods. The Appendix contains some numerical examples.

1023. The Load Distribution in Highway Bridge Decks, by Arnold W. Hendry and Leslie G. Jaeger. (ST) The authors have previously described a new method for the analysis of grid frameworks with particular reference to interconnected bridge girders. It is the purpose of the present paper to show the extension of the method to slabs and to bridge decks having a large number of longitudinal girders. Comparisons are presented between the theoretical load distribution and the results of tests on actual bridges and large models.

1024. Discussion of Proceedings Papers 651, 734, 786, 851, 869, 917. (ST) M. H. Bell closure to 651. A. Hoadley closure to 734. F. P. Drew closure to 786. R. L. Ketter, L. S. Beedle on 851. J. F. Borges on 869. E. Rosenbluth on 917.

1025. Experiences with Loess as Foundation Material, by William A. Clevenger. (SM) In this paper, broad generalizations of many pertinent properties of loess are presented, and the practical significance of these properties is pointed out by typical examples of experience with loess as foundation material.

1026. Redriving Characteristics of Piles, by Nai-Chen Yang. (SM) In evaluating the bearing capacity of a pile, the present technique can be improved. The temporary stress adjustments in the subsoil after pile driving have effects which, to some extent, invalidate the application of pile-driving formulas. For pile-loading tests, the excessive expense often prevents the determination of all quantitative information necessary for conclusive interpretation. The purpose of this paper is to present the results of observations made during the redriving of piles and to discuss their possible applications.

1027. A Brief Note on Compression Index of Soil, by Yoshichika Nishida. (SM) This paper reports a new relationship between the compression index and the void ratio of soils after a theoretical consideration of some simple assumptions. The relationship presented by the author agrees well with experimental results of verification and gives a new approximate method of estimating the compression index of soils as a linear function of the void ratio.

1028. Discussion of Proceedings Papers 514, 755, 842, 861, 862, 866, 940. (SM) D. J. Bleifuss and J. P. Hawke closure to 514. H. Gray closure to 755. L. A. DuBoe, Y. Nishida, J. D. Parsons, and R. B. Peck on 842. G. G. Meyerhof, E. S. Barber on 861. E. J. Zegh, W. A. Brown on 862. N. C. Yang, S. G. Hyland, L. J. Murdock, W. J. Turnbull and R. I. Kaufman, J. A. Focht, Jr., on 866. Corrections to 940.

1029. Creep Relaxation of Plexiglas IIA for Simple Stresses, by Joseph Marin and J. E. Griffith. (EM) Many investigations have been conducted to determine the creep strain-stress-time relations for materials subjected to simple tension and constant stress. However, in a number of applications where creep occurs the stresses do not remain constant and the so-called condition of stress-relaxation occurs. To the authors' knowledge, the only stress-relaxation creep studies conducted in the past have been for the case of simple tension. In this paper, experimental creep-relaxation results for a plastic designated as Plexiglas IIA are obtained for simple tension, simple compression, and pure bending. The agreement between experimental and derived relationships is considered satisfactory.

1030. Suppression of the Fluid-Induced Vibration of Circular Cylinders, by Peter Price. (EM) An investigation of the vibration of circular cylinders in fluid streams has been made in an effort to evolve a means of suppressing the dangerous, wind-induced oscillation of tall steel smokestacks. Exploratory vibration tests of plain and modified cylinders were made over a wide range of cylinder flexibility at subcritical Reynolds numbers in a water channel. These tests established that the enclosure of a cylinder within a concentric perforated shroud was the most effective vibration suppressor at transitional and supercritical Reynolds numbers.

1031. Some Observations on Open Channel Flow at Small Reynolds Numbers, by Lorenz G. Straub, Edward Silberman, and Herbert C. Nelson. (EM) The paper is confined to a summarization and correlation of the results of a number of studies of open channel flow in the range of Reynolds numbers below approximately 4×10^4 . Hydraulic diameter is used as the length parameter in Reynolds numbers. Smooth laminar, smooth turbulent, rough laminar, and rough turbulent flow are considered separately, as is transition from laminar to turbulent flow in smooth channels.

1032. Lateral Bracing Forces on Beams and Columns, by William Zuk. (EM) Slender beams and columns are generally

braced against buckling to increase their strength. Yet little is known about the magnitude of the bracing force and it is usually assumed to be some small value based on engineering judgment. It is therefore the purpose of this paper to derive quantitatively the amounts of bracing force required for eight representative cases of beams and columns. Some of the cases are solved exactly by the direct solution of the basic differential equation whereas others are solved approximately by energy methods. In all cases, the behavior is assumed elastic. Several numerical examples are included which show that the order of magnitude of these bracing forces is small and falls within a limited range.

1033. Discussion of Proceedings Paper 694. (EM) F. E. Richart, Jr., on 694.

August

1034. The Application of Sediment-Transport Mechanics to Stable-Channel Design, by E. M. Laursen. (HY) The three requisites for a stable alluvial channel are explicitly stated and the role of sediment transport in each assessed. The similarity of the many sediment transport formulas is demonstrated and the general method of application to design illustrated. The use of these formulas as scaling relationships between different channels is advocated.

1035. Measuring Evapotranspiration from Atmospheric Data, by G. S. Benton and J. Dornitz. (HY) A method of evaluating evapotranspiration is presented, which is based on the mass balance of water vapor in the atmosphere. The method is applied to various regions of the North American continent for the calendar year, 1949, and the results are compared with hydrologic data and with an empirical method of estimating evapotranspiration. It is shown that, although accurate values of evapotranspiration can be obtained for large areas such as the entire continent, the accuracy of the method is reduced as the size of the area under consideration is decreased. The potentialities and limitations of the proposed method are evaluated.

1036. Principles of Flocculation Related to Water Treatment, by P. D. Haney. (HY) Coagulation includes addition of chemicals, their distribution, floc formation, and floc build-up. The process that leads to floc formation and build-up is termed "flocculation." Flocculation is accomplished by prolonged agitation at low velocity. Colloidal particles play an important role in the complex process of coagulation. Laboratory studies are essential for plant control and flexibility is an important aspect of plant design.

1037. A Flow Controller for Open or Closed Conduits, by V. L. Streeter. (HY) The combination of a disc moving within a profiled throat and an adjustable nonlinear resistance to support the disc against the fluid drag forces is shown to yield a principle of flow control that is infinitely variable and theoretically exact if changes in drag and discharge coefficients are neglected.

1038. Seven Exploratory Studies in Hydraulics, by H. Rouse. (HY) A series of original experiments, which were performed as the final exercise of an advanced class in laboratory techniques, is described. It includes three different aspects of jet mechanics, evaluations of the water-surface configuration at free and submerged overfalls, an analysis of wake-induced vibration, and an investigation of similarity in the flow of stratified fluids.

1039. A New Development in Flow Measurement: The Dall Flow Tube, by A. L. Jorissen. (HY) The Dall flow tube is a modified Venturi tube offering the two-fold advantage of great compactness and very low head loss. The paper describes this new type of instrument and gives values for its coefficient of discharge and expansion factor (for compressible fluids). The effects of various conditions of installation are discussed.

1040. Flood Plain Aspects of River Planning, by A. P. Lunetta. (HY) The flood plains of many rivers are being increasingly regulated by various governmental agencies. No fixed method or formula exists for determining the type or manner of regulation best suited to a specific flood plain. Instead, the regulations must be based on an examination of the hy-

driologic, hydraulic, economic, and social aspects of the problem.

1041. Discussion of Proceedings Papers 744, 806, 826, 1040. (HY) D. M. Hershfield, L. L. Weiss and W. T. Wilson closure to 744. P. Baumann closure to 806. F. A. Johnson on 826. R. L. Smith on 1040.

1042. The Effect of Pore Pressures on Stresses in Gravity Dams, by C. C. Zienkiewicz. (PO) In this paper the problem of stresses arising in a gravity dam because of the action of pore-water pressures is considered. Although the answer to this problem has been derived for a particular type of pressure distribution, the writer seeks to provide a solution for cases that often exist in practice, in which the restrictive assumptions of the known solution do not apply. The case of an idealized, triangular shaped dam is analyzed and a general elastic solution obtained, which is valid for any arbitrary type of pressure variation. Numerical answers are given to a special case in which a line of drains placed inside the dam reduces the pore pressures discontinuously. Some general conclusions are drawn from the results of these computations.

1043. History of Power Cost in New England, by Howard M. Turner. (PO) This paper traces the history of the cost of power in New England from the small water powers of the colonial period through the large industrial water powers, the growth of steam power, the development of the early hydroelectric power companies, and the growth of purchased power by industry, up to the present interconnected public utility systems. Cost figures are given, but emphasis is placed on the methods of production rather than on statistical costs.

1044. Water Supply for Texas Steam Electric Stations, by M. G. Salzman. (PO) This paper describes methods employed for circulating water systems with makeup required principally for evaporative losses. Typical examples are given of Texas plants with on-stream and off-stream reservoirs as cooling ponds, cooling towers with makeup from surface or ground-water supply, and extended circulation in artificial and extended waterways.

1045. Arch Dams: Design and Construction of Ross Dam, by C. E. Shevling and L. R. Scrivner. (PO) This paper discusses the design of the Ross Dam and its three-stepped construction. Outlined are the basic assumptions adopted for the trial-load analyses and the allowable stresses used. Included are computed stresses for the several construction stages. Timing of the various contraction joint grouting programs is also discussed.

1046. Discussion of Proceedings Papers 697, 700, 737, 895, 899, 991. (PO) L. S. Wing and R. H. Griffin closure to 697. R. W. Carlson closure to 700. J. G. Thon and G. L. Coltrin closure to 737. M. C. Bell on 895. C. D. Curran on 899. R. E. Glover on 991.

1047. Some Design Considerations for Oxidation Ponds, by E. F. Gloyna and E. R. Hermann. (SA) The demand for economical sewage disposal systems for small communities has prompted research into some of the design considerations for oxidation ponds with an eye to using the final effluent for irrigation. B. O. D. loadings up to 200 lb per acre per day are possible.

1048. Discussion of Proceedings Papers 687, 846, 885, 887. (SA) C. N. H. Fischersstrom on 687. P. R. Kriege on 846. J. S. Wiley and G. W. Pearce closure to 846. K. Kawata on 885. J. S. Wiley on 887.

1049. Engineering and Malaria Eradication, by P. N. Owens. (SA) This paper describes the steps leading up to the establishment of programs for the eradication of malaria by the countries and territories of the Americas. The responsibilities of engineers in these programs are outlined and a typical program is described. Special problems relating to the design of equipment are also discussed.

1050. Investigations of the Hydrology of Small Watersheds in Texas, by T. Twichell. (SA) With the increased importance of water, it is necessary that basic data be obtained to evaluate (1) the natural occurrence, quantity, and quality of water for a region through extended climatic cycles; (2) the interrelationships of surface and ground water; and (3) the effects of man's developments upon the water resources.

The obtaining and evaluation of this basic data is given for small watersheds in Texas.

1051. Radioactive Sediments in the Tennessee River System, by J. M. Garner, Jr., and O. W. Kochtitzky. (SA) The increased use of radioactive materials poses a definite problem as to their ultimate fate. With nuclear power the engineer must be able to determine the fate of the radioactive wastes discharged into a receiving stream. The equipment and techniques for determining the concentration of radioactivity in river sediments are discussed for the area just below the Oak Ridge National Laboratory.

1052. Coagulation and Sedimentation, by J. M. DallaValle. (HY) By initially assuming a monodisperse system of particles or nuclei, the change of collisions leading to 1, 2, 3, etc., aggregated particles is computed according to the procedure used by Smoluchowski. The effect of settling is ignored by assuming the process to be very fast. The general law of settling of dilute suspensions as well as highly concentrated suspensions is discussed.

1053. The Role of Chemically Combined Oxygen in Biological Systems, by R. E. McKinney. (SA) Oxygen is the most important element in biological waste treatment systems because without oxygen there could be no growth of microorganisms or utilization of organic matter. A general discussion of the relationships of the various forms of combined oxygen to the microorganisms in biological systems is given.

September

1054. Stresses in Pressure Pipelines and Protective Casing Pipes, by M. G. Spangler. (ST) This paper contains an analytical study of stresses in steel pipelines under combined internal fluid pressure and external loads, such as earth backfill and surface traffic loads. Also, a study is made of the deflection of protective casing pipes at pipeline crossings beneath highways, railways, and airport runways.

1055. Prestressed Continuous Beams and Frames, by P. B. Morice and H. E.

Lewis. (ST) This paper describes methods of design for continuous prestressed concrete beams and frames, in particular those of uniform section. Methods for determining suitable tendon profiles are discussed, and it is shown that certain displacements of profiles are possible without affecting the stress conditions. In the case of frames, consideration is given to the effects of varying direct force on section design. The methods of allowing for transom shortening due to prestress are discussed. A comparison is made between simply supported and continuous beam construction, showing that the use of continuity becomes advantageous only when large dead loads occur. It is also shown that the adoption of alternating long and short spans does not lead to economy.

1056. Response of a Rigid Frame to a Distributed Transient Loads, by R. C. DeHart. (ST) This paper presents a method for analyzing the response of a rigid frame structure subjected to a distributed lateral load of a transient nature. The structure is studied from the standpoint that it is a continuous system having a distributed mass. Time-dependent relations for deflections and moment are developed and these quantities are computed for one example.

1057. Hyperbolic Paraboloid and Other Shells of Double Curvature, by Alfred L. Parme. (ST) The paper presents a comprehensive derivation of formulas for the evaluation of the membrane forces acting in any doubly curved shell. For the specific case of elliptical paraboloid shell, numerical tables are given for the ready determination of the stresses. The applicability of these tabular values to other shapes is shown and illustrative examples included.

1058. Moment Distribution Constants from Models, by Otakar Ondra. (ST) The paper describes an experimental method of determining carry-over and stiffness factors, fixed end moments, and displacement effects for beams with variable moments of inertia. The method is based on the concept of a three-dimensional M/EI solid whose properties are evaluated by weighing and the use of statics.

1059. Alternatives to Stone in Breakwater Construction, by Reuben J. Johnson and Olin F. Weymouth. (WW) The type of breakwater construction employed depends on economic considerations, depth and salinity of water, severity of storms, and availability of materials. The difficulty in obtaining armor stone has resulted in investigation of alternatives such as concrete castings in the form of rectangular blocks, tetrahedrons, and tetrapods. Advantages of this type of construction indicate increasing feasibility in future breakwater work.

1060. The Harrison County Artificial Beach, by F. F. Escoffier. (WW) Cooperative studies between Harrison County, Miss., and the Corps of Engineers (United States Department of the Army) led to the pumping of an artificial beach in front of the existing seawall. This beach is proving its value as a protection to the seawall and as a recreational facility.

1061. Growth of Commerce: Tennessee and Cumberland Rivers, by G. M. Dorland and G. R. Bethuram, Jr. (WW) The United States inland waterways system carried over 173 billion ton-miles of freight in 1955, an increase of 101 percent in the past quarter century. The Tennessee and Cumberland Rivers' growth in commerce has greatly exceeded the national average. This paper attempts to present reasons for this growth.

1062. Lower Cumberland Project: Kentucky and Tennessee, by A. E. Dykes. (WW) This \$167,000,000 multipurpose project is a key element in the over-all plan of development of the water resources of the Cumberland River basin. It will be connected with the Tennessee River by a canal, providing for integrated operation with that system for flood control, navigation, hydroelectric power, and allied purposes.

1063. Arrangement of Groins on a Sandy Beach, by Shositiro Nagai. (WW) It is an important and difficult problem to arrange groins effectively for protection against erosion by wave action on a sandy coast. This paper will present the relation of the groins' length, space, and orientation

with respect to the shoreline, the direction of wave propagation, and the breaking point of the breakers. The relationship between wave steepness and sand transport, and some results of experiments concerning special types of groins are also presented.

1064. Coordinated Surveying and Mapping for Industry, by E. D. Morse. (SU) The lasting economies and many advantages deriving from utilization of a plane coordinate system in surveying and mapping are generally acknowledged by civil engineers and land surveyors, although employment of such systems, particularly in industry, is not as widespread as is justified. Rapid expansion of industry, the need for greater precision and efficiency in surveying and mapping operations, and the availability of an increasing number of accurate and permanent control points keyed to the State Plane Coordinate System give added emphasis to this matter.

1065. Uses of Aerial Surveying in Highway Design and Location, by David K. Blythe. (SU) The use of aerial photographs in highway design and location is helping provide better highways for our country; they will play a vital role in the current road building program. This paper explains some of the uses of aerial photographs by citing their use in Kentucky Department of Highways projects.

1066. Discussion of Proceedings Paper 921. (SU) Sumner B. Irish, William A. White on 921.

1067. Discussions of Proceedings Papers 735, 763, 914, 915. (ST) A. S. Veletsos and N. M. Newmark closure to 735. Adrian Pauw closure to 763. A. C. Scordelis, Robert R. Dickey, A. A. Eremin, Jacob Karol on 914. A. A. Eremin, Edward Cohen and Edward Laing on 915.

1068. Discussion of Proceedings Papers 727, 801, 803. (WW) David A. Hopkins closure to 727. Rufus H. Carter, Jr., closure to 801. Walter F. Lawlor closure to 803.

1069. Design Considerations for a New Lock at Wilson Dam, by Robert A. Monroe and George P. Palo. (WW) Navigation of the Tennessee River has increased to such extent that the existing locks at Wilson Dam will soon be inadequate to handle the traffic. This paper discusses the major features of design of a new single-lift lock at Wilson Dam having a lock chamber 110 ft wide by 600 ft long, and with a maximum lift of 100 ft.

October

1070. Truss Analysis by Stiffness Considerations, by Harold C. Martin. (EM) A method is developed for conveniently analyzing redundant trusses by using a stiffness matrix. This procedure is routine as illustrated by examples. Numerical operations on the stiffness matrix leads to a solution that can be made by desk calculator. The method can be extended to other structures.

1071. Plastics, by Gordon M. Kline. (EM) The properties and applications of the various commercial plastics are reviewed. Statistics regarding the consumption of plastics in major end uses in 1955 are presented. Work which is now being undertaken on the development of standards for plastics suitable for use in civil engineering is discussed. References to reports on the economic position and engineering uses of plastics are cited.

1072. Plastics: Engineering Materials, by C. H. Adams. (EM) This paper concerns engineering characteristics of plastics and their reaction to environments of force, time and temperature. Subject will be developed through: (1) comparing plastics with older materials; (2) comparisons of plastics by generic groups; (3) quantitative comparisons of plastics with other materials; and (4) analysis of design considerations for plastics.

1073. Minimum-Weight Design of a Portal Frame, by William Prager. (EM) This paper concerns minimum-weight design of frames assuming that the unit weight of a structural member is proportional to the α -th power of its fully plastic moment, the positive exponent α being smaller than unity. For $\alpha = 2/3$, a chart is developed giving minimum-weight design for various geometrics and loading conditions of a portal frame.

1074. Modernizing a Texas Highway with Concrete, by Allan L. Chollar. (HW) This paper outlines design and construction procedures in planning and constructing concrete resurfacing over a 34-yr old, 16-ft concrete pavement. The new 24-ft pavement is part of the 4-lane divided modernization of this highway. Construction details of longitudinal and transverse jointing procedures are described.

1075. Economics of Self-Protection of Highways Against Flood Damage, by J. C. Young. (HW) Flood-protection economics for highways must take into account engineering, legal, and public interest considerations, both tangible and intangible. To reach sound decisions, it is important to know the limitations of economic analysis. This paper gives an appraisal of the factors involved and the logic of their application.

1076. Foreign Operations of the Bureau of Public Roads, by A. C. Taylor. (HW) This paper describes how the Bureau of Public Roads (United States Department of Commerce) is extending highway technical assistance to foreign countries. Arrangements under which this program is carried on and administered and the status of work in several countries, the program's aims, and the difficulties of recruiting personnel are set forth.

1077. Flood Protection of Canals by Lateral Spillways, by H. Tufts. (HY) Water-level profiles in front of lateral spillway crests can be computed by Bernoulli and continuity equations. Nonuniform velocity distribution is taken in account. Examples demonstrate the limitations of application of lateral spillways and possibilities of improving discharge capacities by enlarging cross sections and placing additional orifices behind spillways.

1078. SED Research Report No. 8: On Treatment of Alkaline Sulfur Dye Waste with Flue Gas, by The Sanitary Engineering Research Committee, Industrial Wastes Section. (SA) The authors describe the results obtained when treating alkaline sulfur-containing dye wastes in a jet-flue pilot plant.

1079. Pile Tests, Low-Sill Structure, Old River, La., by C. I. Mansur and R. I. Kaufman. (SM) Pipe and H-beam piles founded in sand underlying 50 ft of silt were tested in

tension and compression. Distribution of load along the pile and at the tip was determined from strain rods. Skin friction in silt and sand and tip-bearing capacity in sand were also determined.

1080. Foundation Studies for Delong Piers, by W. G. Shockley and T. B. Goode. (SM) Results of experimental investigations of the bearing capacity of 6-ft-diameter pier barge spuds in three types of foundation soil are presented. Bearing capacities computed from existing formulas for large cylindrical piers and results of field penetration tests are correlated with measured bearing capacities of the spuds.

1081. Soil Modulus for Laterally Loaded Piles, by Bramlette McClelland and John A. Focht, Jr. (SM) Using results from a lateral-load test on a 24-in. pipe pile and laboratory tests on undisturbed clay samples, a tentative procedure is developed for estimating the soil modulus of pipe reaction in problems involving transient loads. The correlation derived is based on the similitude on logarithmic paper of laboratory stress-strain curves and soil-deflection curves from the pile test.

1082. The Problem of Reservoir Capacity for Long-Term Storage, by A. Fathy and Aly S. Shukry. (HY) In this paper a method is suggested for the systematic analysis of hydrological observations in order to obtain a full representation of the capacity-yield relation for long-term storage in any given case. The cost-yield relation could readily be determined and the choice of capacity could be made in full view of all physical and economic factors involved.

1083. Sedimentation Studies, by D. E. Bloodgood, W. J. Boegly, and C. E. Smith. (SA) Sedimentation studies were carried out in the laboratory to substantiate Hazen's theory that sediment removal is dependent on surface area and independent of depth. Results showed removal of sediment was dependent on the force of the incoming water.

1084. An Improved Dilution Method for Flow Measurement, by W. A. Cawley and J. W. Woods. (SA) A procedure is outlined for measuring flow in sewers containing industrial wastes by a manganese dilution method. An inexpensive technical grade of manganous sulphate was injected into the

sewers and the degree of dilution determined quantitatively by flame spectrophotometric analysis. It is felt that this approach provides an accurate and relatively simple method for use with industrial wastes.

1085. Municipal Ordinances for Industrial Wastes, by Julian R. Fleming. (SA) The problem of municipal ordinances for handling industrial wastes in municipal sewerage systems and sewage treatment plants is discussed from experiences at Knoxville, Tenn.

1086. Hydro-Electric Power in the Southeast, by C. P. Lindner and L. F. Johnson. (PO) This paper reviews the history of hydroelectric development in the southeast. Contrary to widespread impression, many potential sites still remain undeveloped which can become economical by constructing multipurpose projects in which each element contributes a fair share of its cost.

1087. SED Research Report No. 9: Evaluation of Water Resources of a River Basin, by The Sanitary Engineering Research Committee, Water Section. (SA) A rational method of evaluating the water resources of a river basin is developed and applied to the Neuse River Basin in North Carolina.

1088. New Developments in Septic Tank Systems, by John E. Kiker, Jr. (SA) During the past few years there have been some important changes in the design criteria for septic tanks and subsurface sewage disposal systems. These changes are set forth and evaluated.

1089. Preliminary Studies on Complete Anaerobic Sewage Treatment, by J. B. Coulter, S. Soneda, and M. B. Ettinger. (SA) Laboratory studies are described for the development of anaerobic contact sewage treatment system for use in small subdivisions which produces an effluent low in B.O.D. and suspended solids.

1090. The Highway Spiral as a Centerline for Structures, by Paul Hartman. (HW) This paper presents a method for computing the geometry of a structure with a spiral centerline. The method is simple and precise enough for steel work. The amount of computation is no greater than that required

for the multicentered curve which customarily replaces a spiral on a structure.

1091. Discussions of Proceedings Papers 817, 818, 945, 1030. (EM) Chong-Hung Zee, Dean F. Peterson, and Robert O. Bock closure to 817. Daniel Frederick closure to 818. E. Silberman, N. N. Ambraseys on 945. G. W. Housner on 1030.

1092. Discussions of Proceedings Papers 714, 745, 747, 840, 953, 1006. (HY) J. J. Dronkers and J. C. Schonfeld closure to 714. E. W. Lane closure to 745. M. B. McPherson and H. S. Strausser closure to 747. Herbert M. Corn closure to 840. Arthur I. McCutchan, Sam Shulits on 953. Achille Lazard on 1006.

1093. Discussions of Proceedings Papers 703, 783. (HW) Corrections to 703. C. J. Posey closure to 783.

1094. Discussions of Proceedings Papers 696, 742, 959. (PO) M. Rocha, J. Laginha Serafim, A. F. da Silveira, and J. M. Resurreição Neto closure to 696. T. C. Powers closure to 742. Ross M. Riegel on 742. G. S. Sarkaria, George E. Goodall on 959.

1095. Discussions of Proceedings Papers 757, 862, 866, 934, 940, 941, 1026. (SM) Horace A. Johnson closure to 757. C. Y. Li closure to 862. E. de Beer and A. Martens on 866. G. A. Leonards, John A. Focht, Jr., E. J. Zegarra, K. B. Hirashima on 934. L. A. Palmer, David A. Hopkins on 940. John V. Spielman, Nicols N. Ambraseys on 941. A. A. Eremin on 1028.

November

1096. Internal Ties in Slope Deflection and Moment Distribution, by Morris Ojalvo. (ST) This paper outlines a procedure which can be used in the slope deflection and moment distribution methods of analysis when the joints of a rigid frame are free to translate; this procedure makes use of imaginary internal ties. In moment distributions these ties may be considered as the restraints which prevent joint translation during the balancing of the moments. The procedure becomes increasingly useful for more complicated structures and does not complicate

analysis of simpler structures. The versatility of moment distribution and slope deflection is retained or enhanced.

1097. Influence Lines for Circular Ring Redundants, by Henry M. Lummis. (ST) The engineer is frequently called upon to analyze circular rings for maximum bending moments, shear, and thrust. The influence lines presented with this paper obviate the necessity of resorting to indeterminate analysis of formulas for the solution, and the ring can be analyzed statically much the same as a simple beam.

1098. Earthquake Stresses in Building Floors, by Charles S. Glazbrook. (ST) The paper presents a method of approach to the analysis of stresses in building floors, which must distribute earth-shock loads coming onto them from above to the resisting elements below the floors.

1099. Ultimate Strength Design Under 1956 Building Code, by Raymond C. Reese. (ST) This paper shows how ultimate strength design is recognized for the first time in *Building Code Requirements for reinforced Concrete* (ACI 318-56), explains that this is ultimate strength design, not limit design (moments being obtained by elastic-frame analysis), shows the need for controlling shallow sections by deflection calculations, and points out that ultimate strength procedures are easier to apply and give more realistic results than working stress formulas.

1100. The Painting of Structural Steel, by E. J. Ruble. (ST) A review of research being conducted on the painting of steel structures is presented. The contents and use of the Painting Manual prepared by the Steel Structures Painting Council is discussed. Included is a description of the many tests being conducted by the Council on actual structures to determine the best methods of protecting the steel against severe corrosive conditions, such as brine drippings from refrigerator cars.

1101. Analysis of Ribbed Domes with Polygonal Rings, by Tsze-Sheng Shih. (ST) This paper presents methods of analysis of rigidly connected ribbed domes. Under a fully symmetrical loading, the dome is analyzed exactly by direct application of

Castigliano's theorem. For antisymmetrical loads and symmetrical loads on two opposite ribs, auxiliary force systems and finite trigonometric series are used. By combining the latter two conditions, a solution for general loading is obtained.

1102. The Peoria Recharge Pit: Its Development and Results, by Max Suter. (IR) Research on artificial recharge was done in Peoria, Illinois, by the State Water Survey to find methods for overcoming the losses in ground-water storage due to overpumpage. A method was found to obtain the high rate of inflow from 23 to 27 mgd per acre. Many types of hydrologic, chemical, and bacteriological observations were made; some of the relationships found cannot yet be explained.

1103. "Safe Yield" in Ground-Water Development, Reality or Illusion?, by Raphael G. Kazmann. (IR) Definitions of "safe yield" are critically examined and found inadequate. The effects of embodying such a term in laws controlling the utilization of ground water are noted. An alternate, more feasible approach to the problem of ground-water control, based on the functional utilization of aquifers, is proposed.

1104. Evaporation from Free Water Surfaces at High Altitudes, by Harry F. Blaney. (IR) In the western United States, evaporation losses from reservoirs and lakes at high altitudes are important as an element affecting the net water supply available for irrigation crops, production of power, and municipal and industrial purposes. Except in unusual instances, evaporation cannot be measured directly from large water areas. Thus, it is common practice to measure evaporation from pans and use coefficients to reduce pan evaporation to lake evaporation. At high altitudes it is seldom possible to measure evaporation during the winter months because the water in the pans freezes. This paper presents data on evaporation in several western states and develops a method of estimating monthly evaporation for the entire year from temperature and other data.

1105. Irrigation Requirements Based on Climatic Data, by George H. Hargreaves. (IR) This paper shows the limitations of present methods of using climatic data in the

computation of consumptive use and irrigation requirements. Water evaporation is considered as a physical process. Physical laws, climatic data, and theoretical considerations are used in deriving new equations for determining consumptive use or evapo-transpiration potential for any set of climatic conditions. A formula, based on use of evapo-transpiration potentials, is developed for transferring consumptive-use data from one set of climatic conditions to another. Climatic regions for the United States are described and use of consumptive-use data in computing of consumptive use for any given set of climatic and cropping conditions.

1106. Simplified Analysis of Rigid Frames, by Robert M. Barnoff. (ST) A procedure to reduce the time required to analyze rigid frames is presented in this paper. Formulas for balanced moments at the joints of four types of rigid frames are plotted on diagrams in order to simplify the numerical computations.

1107. Cable Friction in Post-Tensioning, by T. Y. Lin. (ST) The sources of frictional loss of prestress are discussed; data for the coefficients of friction under various conditions are presented; and methods for measuring and for reducing frictional losses are described.

1108. Effect of Bearing Ratio on Static Strength of Riveted Joints, by Jonathan Jonea. (ST) This paper offers evidence that, in riveted joints of usual structural proportions subjected to substantially static loads, the joint strength will not be reduced if the ratio of rivet-bearing stress to axial or shearing stress is increased above that sanctioned by most specifications for steel buildings and bridges.

1109. Airport and City Planning, by Leigh Fisher. (AT) The author, studying the thesis that there is insufficient correlation between planning for airports and regional development planning, analyzes the specific factors which should be considered to achieve better integration of the airport with the community it serves. Ground transportation, airport-to-community distance, approach zoning, noise nuisance, and land use are some of the factors considered.

1110. Discussions of Proceedings Papers 720, 987. (AT) Robert Horonjeff and John Hugh Jones closure to 720. Corrections to 987.

1111. Discussions of Proceedings Papers 705, 706, 728, 788, 884, 961. (IR) Howard T. Critchlow closure to 705. Robert O. Thomas closure to 706. A. R. Robinson and Carl Rohwer closure to 728. M. Gamal Mostafa closure to 788. D. M. Forester on 884. Frederick L. Hotes, Wendell E. Johnson and Charles A. Cocks, Eugene W. Weber on 961.

1112. Discussions of Proceedings Papers 680, 735, 829, 914, 916, 917, 920, 973, 1019. (ST) Corrections to 680. Corrections to 735. Ephraim G. Hirsch and E. P. Popov closure to 829. Howard H. Mullins on 914. Corrections to 916. Leonardo Zeevaert closure to 917. R. B. Matthiesen and R. L. Moore on 920. R. K. L. Wen on 973. Cevdet Z. Erzen on 1019. Corrections to 1019.

December

1113. Fluid Resistance to Cylinders in Accelerated Motion, by S. R. Keiza. (HY) Real fluid resistance to cylinders in nonuniform motion was investigated. A rational correlation was found to exist between the resistance coefficient and an acceleration modulus using Reynolds number and length-diameter ratio as parameters. Quantitative data used in the analysis was obtained by accelerating cylinders vertically from rest in water.

1114. Graphical Determination of Water-Surface Profiles, by Francis F. Escoffier. (HY) Tables of functions, such as those of Bresse and Bakhmeteff, which are used to estimate water-surface profiles in uniform channels, have been published from time to time. In the present paper a graphical method is developed which greatly facilitates the use of these functions.

1115. The Mechanism of Reaeration in Natural Streams, by Donald J. O'Connor and William E. Dobbins. (SA) Turbulent

flow theory has been utilized to formulate the theory of reaeration in natural streams. Laboratory experiments and field studies were used to check and substantiate the theoretical formulas.

1116. Air Pollution Studies at University of California at Los Angeles: SED Report No. 10, Sanitary Engineering Research Committee, Air Pollution Section, (SA) This paper discusses an air pollution research project involving methods of air analysis, air pollution control devices, refuse-incineration problems, meteorological factors, a full-scale pollution test, and results of long-range pollution studies. An analysis is also presented of the first report of the air-pollution studies conducted at the University of California.

1117. Experience of the Bureau of Public Roads in Highway Surveys, by William T. Pryor. (SU) New methods and practices in surveying are now ready to fulfill present needs throughout all states in the rapidly expanding highway construction program. Ground survey methods cannot be *supplanted*, but can, and should be, *supplemented* by photogrammetry and aerial surveys to attain better surveys and highways in less time with fewer engineers.

1118. The Use of Photogrammetry to Civil Engineers, by William O. Baker. (SU) A discussion of the many uses of photogrammetry in aiding the civil engineer to design highways, water and sewerage systems, power transmission lines, airports, and city development. Savings in cost and time are illustrated by specific projects in which photogrammetric methods are used instead of conventional ground surveys.

1119. Anchorages for Large Tainter Gates, by A. H. Kenigsberg. (WW) In this paper are discussed novel-type anchorages, whose distinguishing features and economy derive from a single tie girder placed centrally within the spillway pier, a single anchor at the upstream end of the girder, and its downstream end in a concentric grouping with the inclined side arms of adjacent tainter gates.

1120. The Apalachicola River Basin Project, by C. P. Lindner. (WW) The federal project for the Apalachicola River Basin provides for improvement of the

Apalachicola River for 9-ft navigation, 3 locks and dams (2 with power facilities), and a dam for flood control, power production, and stream flow regulation. Unique features of design and unusual construction problems are discussed in this paper.

1121. The Development of the Cumberland River Basin, by Frank P. Gaines and John T. Dennison. (WW) The plan provides for a 9-ft navigation channel from the Ohio River to Carthage, Tennessee, a distance of over 300 miles. It also provides for substantial flood flow reductions in the Cumberland, Ohio, and Mississippi Rivers, and for over 1,000,000 kw of hydroelectric power capacity with an estimated output of over $3\frac{1}{2}$ billion kwh annually.

1122. Modern Towboat and Barge Design, by Harry B. Dyer. (WW) A brief history of commerce on the Mississippi and Missouri Rivers is given, together with a discussion of improvements in towboat and barge design which have resulted in more efficient use of inland waterways.

1123. Current Trends in Ohio River Traffic and Equipment, by Charles F. Michiels, William F. Lail, and Robert E. Mytinger. (WW) This paper presents a brief history of navigation on the Ohio River; describes how traffic patterns and towing equipment characteristics affected the original plan of canalization; and discusses why current trends in traffic and equipment must be considered to be governing factors in the design of replacement navigation structures now being constructed.

1124. Discussions of Proceedings Papers 965, 975. (WW) Austin E. Brant, Ersel G. Lantz on 965. Corrections to 975.

1125. Discussions of Proceedings Papers 858, 859. D. C. Drucker on 858. L. E. Grinter closure to 858. Alfred L. Golze on 859. Benjamin A. Whisler closure to 859.

1126. Sanitary Engineering Research—The Role of Research Grants, by Harry A. Faber, Harvey F. Ludwig, and Harry G. Hanson. (SA) Research in sanitary engineering is vital for future developments in

this field. Much of the research is sponsored by the United States Public Health Service through research grants from the National Institutes of Health. A general discussion of the research grant program is given.

1127. Knoxville Sewage Treatment Plant, by Kenneth V. Hill. (SA) A complete description with detailed design data of the Knoxville sewage treatment plants are given. A complete breakdown of the cost figures are given as well as the method for financing the system.

1128. Local Flood-Protection Projects, Ohio River Basin, by S. M. Bailey, R. E. Karlen, and Harry Pockras. (WW) Local flood protection projects consist of levees, concrete walls, traffic closures, interior drainage facilities, pumping plants, and channel improvements. General requirements for planning and design of the various parts of the projects are presented in this paper. Information is included as to the effectiveness of one of the projects during a flood.

1129. Discussions of Proceedings Papers 847, 1002. (SA) Nelson L. Nemerow closure to 847. Ralph Stone on 1002.

1130. Discussions of Proceedings Papers 740, 997. (PO) Charles E. Buettner and Paul A. Pickel closure to 740. Corrections to 997. Robert E. Glover on 997.

1131. Discussions of Proceedings Papers 1005, 1009. (HY) Corrections to 1005. Fred W. Blaisdell on 1009.

1132. Design of the Eklutna Project, Alaska, by Frank B. Cook and David L. Goodman. (PO) This paper describes the design of the Eklutna Project, a hydroelectric power development of the Bureau of Reclamation near Anchorage, Alaska. Included in the paper are a description of the over-all purpose and function of the project and a detailed summary of the design of the principal power facilities.

1133. Description of Repairs to Spillway Piers of Keokuk Dam, by Ralph L. Shelton and Frank L. Burgrabbe. (PO) This paper

describes the rehabilitation of the spillway piers of this dam after more than 40 years of service. Deteriorated concrete was removed and replaced with temperature-reinforced concrete anchored to sound concrete of piers,

1134. Observed Behavior of Several Italian Arch Dams, by Dino Tonini. (PO) A summary of the results obtained from the analysis of deflection, strain, temperature, and other measurements on nine Italian arch dams is presented. The important way in which temperature changes influence arch dam behavior is shown. The results of testing for foundation modulus by seismic

methods before, during, and after construction of arch dams are described.

1135. Abstracts and Index to Proceedings, Volume 82 (1956), by the Board of Direction. (BD) A list of abstracts and a subject and author index have been prepared for all Proceedings Papers published in 1956; the numbers covered are 861 to 1135. The subject headings used were taken from the names of the technical divisions of the Society; other headings were added when deemed necessary. By use of the author index, it is possible to trace all the discussion that a paper has received.

Subject Index

AIR TRANSPORT

- "Airport and City Planning" (1109) by Leigh Fisher
- "A Pattern of Interstation Airline Travel" (987) by D. M. Belmont
- Clo (902) of "Airfield Pavement Design of the Corps of Engineers" (458) See McFadden, Gayle
- Clo (902) of "Jet Transport Economics—Influence on Airport and Airway" (241) See Borger, J. G.
- Clo (902) of "Base Course and Bituminous Pavement Requirements" (424) See Turnbull, W. J.
- Clo (1110) of "The Effect of Traffic Upon Runway Pavement Cross-Section" (720) See Horonjeff, Robert
- Dsc (902) of "Airfield Pavement Design of the Corps of Engineers" (458) See McFadden, Gayle
- Dsc (902) of "The Effect of Traffic upon Runway Pavement Cross-Section" (720) See Horonjeff, Robert
- "The Design of Non-Rigid Overlays for Concrete Airfield Pavements" (979) by Frank M. Mellinger and James P. Sale
- "The Effect of Airport Distance on Traffic Generation" (978) by James C. Buckley
- "The New Federal-Aid Airport Program" (989) by Herbert H. Howell
- "What is the Story of Aviation Today?" (980) by Joseph D. Blatt

ALUMINUM

- Rt "Specifications for Structures of Aluminum Alloy 6061-T6: Second Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys" (970) J. W. Clark, Chmn
- Rt "Specifications for Structures of Aluminum Alloy 2014-T6: Third Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys" (971) J. W. Clark, Chmn

ATOMIC ENERGY

- "Effects of Nuclear Reactor Radiations on Structural Materials" (918) by Ira F. Zariman
- "Meteorology as Related to Reactor Site Selection" (1001) by Fred D. White and Donald H. Pack
- "Radioactive Sediments in the Tennessee River System" (1051) by J. M. Garner and Oscar W. Kochitzky
- "Waste Disposal as Related to Site Selection" (1000) by Arthur E. Gorman

BEAMS

- "Lateral Bracing Forces on Beams and Columns" (1032) by William Zuk
- "Vibrations of Beams on Many Supports" (863) by John W. Miles

BOARD OF DIRECTION

- Clo (1125) of "Education of Civil Engineers: Need for Reconsideration" (858) See Grinter, L. E.
- Clo (1125) of "Education of Civil Engineers: Training for Civil Engineers" (859) See Whisler, Benjamin A.

- Dsc (1125) of "Education of Civil Engineers: Need for Reconsideration" (858) See Grinter, L. E.

- Dsc (1125) of "Education of Civil Engineers: Training for Civil Engineers" (859) See Whisler, Benjamin A.

BOLTS

- "Tests on Bolted Connections in Light Gage Steel" (920) by George Winter

BRIDGES

- "Bridge Clearances: Policies and Practice" (935) by Eugene W. Weber
- "Bridge Clearance: Problem Needs Realistic Approach" (937) by William E. Cleary
- "Bridge Clearances: Problems in North-eastern United States" (939) by Erhard E. Dittbrenner
- "Bridge Clearances: The Interest of the Bureau of Public Roads" (936) by Walter Kurylo
- "Bridge Clearances: The Operator's View" (938) by N. L. Caruthers
- "Development and Design of the Walt Whitman Bridge" (1019) by Milton Brumer and C. W. Hanson
- "Dynamic Stresses in Continuous Plate Girder Bridges" (973) by Roy C. Edgerton and Gordon W. Beecroft
- "The Load Distribution in Highway Bridge Decks" (1023) by Arnold W. Hendry and Leslie G. Jazzer

CALIFORNIA

- "Control of Highway Access: Experiences in Los Angeles" (874) by Hugo H. Winter
- "Control of Highway Access: User Benefits in California" (875) by Ralph A. Moyer
- "Pollution of Los Angeles and Long Beach Harbors" (891) by Linne C. Larson
- Rt "Pilot Plant Composting of Municipal Garbage at San Diego, California" (887) Ralph Stone, Chmn

CHANNELS

- "Design of Stable Canals and Channels in Erodible Material" (880) by Pete W. Terrell and Whitney M. Borland
- "Developing Port Facilities on Houston's Ship Channel" (965) by Frank H. Newman, Jr.
- "Free-Surface Disturbances Along A Channel Wall" (1005) by Amein M. Amein and Melville S. Priest
- "Some Observations on Open Channel Flow at Small Reynolds Numbers" (1031) by Lorenz G. Straub, Edward Silberman and Herbert C. Nelson
- "The Application of Sediment-Transport Mechanics to Stable-Channel Design" (1034) by Emmett M. Laursen
- "Transition Profiles in Non-Uniform Channels" (1006) by Francis F. Escoffier

CITY PLANNING

- "Airport and City Planning" (1109) by Leigh Fisher
- "Design of the Modern Industrial Plant" (963) by Edward X. Tuttle

CITY PLANNING

- "Industry Location Factors" (886) by Jerome P. Pickard
- "Planned Industrial Districts" (879) by Victor Roterus
- "Transportation Planning: Prospects for Coordination" (888) by Burton W. Marsh
- "Transportation Planning: The Airport, A National Facility" (894) by Wilfred M. Post, Jr.
- "Transportation Planning: The Port—A Focal Point" (893) by Roger H. Gilman
- "Urban Redevelopment Can Implement Mass Transit" (964) by William H. Claire

COLUMNS

- "Inelastic Buckling of Non-Uniform Columns" (943) by John E. Goldberg, John L. Bogdanoff, and Hsu Lo
- "Lateral Bracing Forces on Beams and Columns" (1032) by William Zuk

CONCRETE

- "Modernizing a Texas Highway with Concrete" (1074) by Allan L. Chollar

CONSTRUCTION

- "Alternatives to Stone in Breakwater Construction" (1059) by Reuben J. Johnson and Olin F. Weymouth

DAMS

- "Arch Dams: Design and Construction of Ross Dam" (1045) by C. E. Shevling and L. R. Scrivener
- "Arch Dams: Design and Observation of Arch Dams in Portugal" (997) by M. Rocha, J. Laginha Serafim, and A. F. da Silveira
- "Arch Dams: Design of the Kamishliba Arch Dam" (1018) by C. C. Bonin and H. W. Stuber
- "Arch Dams: Development in Italy" (1017) by Carlo Semenza
- "Arch Dams: Isolato Double-Curvature Arch Dam" (995) by Claudio Marcello
- "Arch Dams: Measurements and Studies on Santa Giustina Dam" (993) by Claudio Marcello
- "Arch Dams: Portuguese Experience with Overflow Arch Dams" (990) by A. C. Xerez
- "Arch Dams: Rio Freddo Dam with Gravity Abutments and Cut-offs" (996) by Claudio Marcello
- "Arch Dams: Santa Giustina Single-Curvature Arch Dam" (992) by Claudio Marcello
- "Arch Dams: Their Philosophy" (959) by Andre Coyne
- "Arch Dams: Theory, Methods, and Details of Joint Grouting" (991) by A. Warren Simonds
- "Arch Dams: The Reno Di Lei Double-Curvature Arch Dam" (994) by Claudio Marcello
- "Arch Dams: Trial Load Studies for Hungry Horse Dam" (960) by R. E. Glover and Merlin D. Copen
- "Earthquake Resistance of Rock-Fill Dams" (941) by Ray W. Clough and David Pirtz
- "Fish Passage Facilities at McNary Dam" (895) by Glenn H. Von Gunten, Hugh A. Smith, Jr., and Berton M. Maclean
- "McNary Dam—Coordination of Project Design and Construction" (951) by Otto R. Lunn
- "Project Construction at McNary Dam" (950) by S. G. Neff and J. J. Morton

- "The Effect of Pore Pressures on Stresses in Gravity Dams" (1042) by O. C. Zienkiewicz

DRAINAGE

- "Design of Major Drainage Canals" (962) by Edwin W. Eden, Jr.
- Dsc (903) of "General Aspects of Planned Ground Water Utilization" (706) See Thomas, Robert O.
- Dsc (903) of "Measurement of Canal Seepage" (728) See Robinson, A. R.
- Dsc (903) of "Riverbed Degradation Below Large Capacity Reservoirs" (788) See Mostafa, M. Gamal

EARTHQUAKE

- "Earthquake Stresses in Building Floors" (1098) by Charles S. Glazbrook
- "Earthquake Stresses in Spherical Domes and in Cones" (974) by E. P. Popov

ECONOMICS

- "Cost Allocation for Multi-Purpose Water Projects" (961) by N. B. Bennett, Jr.
- "Economic Aspects of Flood Plain Zoning" (882) by H. W. Adams
- "Economic Criteria for Water Development Projects" (977) by Jewell J. Rasmussen
- "Economics of Self-Protection of Highways Against Flood Damage" (1075) by J. C. Young
- "Foreign Operations of the Bureau of Public Roads" (1076) by A. C. Young
- "History of Power Costs in New England" (1043) by Howard M. Turner

EDUCATION

- "Highway Engineering Manpower: Engineering Education Aspects" (984) by Harmer E. Davis

ENGINEERING MECHANICS

- Clo (876) of "A New Approach to Turbulent Boundary Layer Problems" (604) See Ross, Donald
- Clo (876) of "Failure of Plain Concrete under Combined Stresses" (874) See Bresler, Boris
- Clo (946) of "A Resistor-Network Solution of the Elasto-Plastic Torsion Problem" (671) See Weiner, J. H.
- Clo (946) of "Blast Resistant Building Frames" (687) See Johnston, Bruce G.
- Clo (946) of "Virtual Mass and Acceleration in Fluids" (670) See Stelson, T. E.
- Clo (1033) of "Analysis for Sheet Pile Retaining Walls" (694) See Richart, F. E. Jr.
- Clo (1091) of "Flow into a Well by Electric and Membrane Analogy" (817) See Zee, Chong-Hung
- Clo (1091) of "Thick Rectangular Plates on an Elastic Foundation" (818) See Frederick, Daniel
- "Creep Relaxation of Plexiglass IIA for Simple Stresses" (1029) by Joseph Marin and J. E. Griffith
- Dsc (876) of "Failure of Plain Concrete under Combined Stresses" (874) See Bresler, Boris
- Dsc (946) of "Flow into a Well by Electric and Membrane Analogy" (817) See Zee, Chong-Hung
- Dsc (946) of "Thick Rectangular Plates on an Elastic Foundation" (818) See Frederick, Daniel
- "Inelastic Buckling of Non-Uniform Columns" (943) by John E. Goldberg, John L. Bogdanoff, and Hsu Lo

ENGINEERING MECHANICS

- "Lateral Bracing Forces on Beams and Columns" (1032) by William Zuk
- "Minimum-Weight Design of a Portal Frame" (1073) by William Prager
- "On the Deflections of Bow Girders of Non-Circular Shapes" (870) by Enrico Volterra
- "Plastics" (1071) by Gordon M. Kline
- "Plastics: Engineering Materials" (1072) by C. H. Adams
- "Some Observations on Open Channel Flow at Small Reynolds Numbers" (1031) by Lorenz G. Straub, Edward Silberman and Herbert C. Nelson
- "Suppression of the Fluid-Induced Vibration of Circular Cylinders" (1030) by Peter Price
- "The Dynamic Response of Tall Structures to Lateral Loads" (944) by L. Schenker
- "The Viscous Sublayer Along a Smooth Boundary" (945) by H. A. Einstein and Huon Li
- "Truss Analysis by Stiffness Considerations" (1070) by Harold C. Martin
- "Vibrations of Beams on Many Supports" (863) by John W. Miles

FLOODS

- "Economic Aspects of Flood Plain Zoning" (882) by H. W. Adams
- "Flood Plain Aspects of River Planning" (1040) by Anthony M. Lunett
- "Flood Plain Zoning as Supplement to Flood Control" (954) by Emil P. Schulten
- "Flood Protection at Wichita and Valley Center, Kan." (966) by Myron W. DeGuer
- "Flood Protection of Canals by Lateral Spillways" (1077) by Harald Tulis
- "Local Flood-Protection Projects, Ohio River Basin" (1128) by S. M. Bailey, R. E. Karlen, and Harry Pockras
- "Trinity River Flood Control Project" (927) by James A. Cotton and W. E. Wood
- "Use of Zoning Principles in Flood Plain Regulation" (957) by Joseph I. Perrey
- "Water Resources and Power Studies, Task Force, Hoover Commission: Flood Control" (900) by W. W. Horner

FOUNDATIONS

- Clo (942) of "Foundation Treatment for Earth Dams on Rock" (548) See Thompson, Thomas F.
- Dsc (942) of "Seepage Forces in a Gravity Dam by Electrical Analogy" (757) See Johnson, Horace A.
- Dsc (1028) of "The Action of Soft Clay Along Friction Piles" (843) See Seed, H. B.
- "Earthquake Resistance of Rock-Fill Dams" (941) by Ray W. Clough and David Pirtz
- "Experiments with Locas as Foundation Material" (1025) by William A. Clevenger
- "Foundation Studies for Delong Piers" (1080) by W. G. Shockley and T. B. Goode
- "Old River Diversion Control: Foundation Design" (908) by W. J. Turnbull and W. G. Shockley
- "Pile Tests, Low-Sill Structure, Old River, La." (1079) by C. I. Mansur and R. I. Kaufman
- "Redriving Characteristics of Piles" (1026) by Nai-Chen Yang
- "Soil Modulus for Laterally Loaded Piles" (1081) by Bramlette McClelland and John A. Focht, Jr.

- "Structural Rigidity in Calculating Settlements" (865) by Samuel Chamecki
- "Thrust Loading on Piles" (940) by James F. McNulty

FRAMES

- "Response of a Rigid Frame to a Distributed Transient Load" (1056) R. C. DeHart
- "Simplified Analysis of Rigid Frames" (1106) by Robert M. Barnoff

GEOLOGY

- "Geology of Some American Estuarine Harbors" (956) by Parker D. Trask

HARBORS

- "Arrangement of Groins on a Sandy Beach" (1063) by Shosittiro Nagai
- "Design Problems Involved in Protection from Tsunamis" (968) by Kenneth Kaplan
- "Developing Port Facilities on Houston's Ship Channel" (965) by Frank H. Newnam, Jr.
- "Wave Run-Up on Shore Structures" (925) by Thorndike Saville, Jr.

HIGHWAYS

- "Analysis of a Skew Diversion" (868) by Wen-Hsiung Li
- Clo (877) of "Determining the Required Thickness of Concrete Pavements for Highways" (596) See Moore, Joseph Herbert
- Clo (1093) of "Flood-Erosion Protection for Highway Fills" (783) See Posey, C. J.
- "Control of Highway Access: Economic Effects of the Gulf Freeway" (872) by D. C. Greer
- "Control of Highway Access: Experiences in Indiana" (873) by Carl E. Vogelgesang
- "Control of Highway Access: Experiences in Los Angeles" (874) by Hugo H. Winter
- "Control of Highway Access: Experiences in New York" (871) by B. D. Tallamy
- "Control of Highway Access: User Benefits in California" (875) by Ralph A. Moyer
- Dsc (877) of "Flood-Erosion Protection for Highway Fills" (783) See Posey, C. J.
- Dsc (985) of "The Highway Spiral for Combining Curves of Different Radii" (703) See Hartman, Paul
- Dsc (985) of "Flood-Erosion Protection for Highway Fills" (783) See Posey, C. J.
- Dsc (985) of "Using Consultants to Expand a Highway Program" (824) See Whitton, Rex M.
- "Economics of Self-Protection of Highways Against Flood Damage" (1075) by J. C. Young
- "Experience of the Bureau of Public Roads in Highway Surveys" (1117) by William T. Pryor
- "Foreign Operations of the Bureau of Public Roads" (1076) by A. C. Taylor
- "Highway Engineering Manpower: Engineering Education Aspects" (984) by Harmer E. Davis
- "Highway Engineering Manpower—Recruiting and Training of Graduates" (983) by Robley Winfrey
- "Modernizing a Texas Highway with Concrete" (1074) by Allan L. Chollar
- "The Highway Spiral as a Centerline for Structures" (1090) by Paul Hartman
- "Uses of Aerial Surveying in Highway Design and Location" (1065) by David K. Blythe

HYDRAULICS

"A Flow Controller for Open or Closed Conduits" (1037) by Victor L. Streeter

"A New Development in Flow Measurement: The Dall Flow Tube" (1039) by Andre L. Joris-
sen

Clo (881) of "Surface-Water Supply for Irrigation in the Vermilion River Basin, Louisiana" (489) See Hendricks, E. L.

Clo (881) of "The Log-Probability Law and its Engineering Applications" (536) See Chow, Ven Te

Clo (881) of "Scale Relations among Sand-Bed Rivers Including Models" (667) See Blench, Thomas

Clo (1010) of "A More Simplified Venturi Tube" (678) See Stevens, J. C.

Clo (1010) of "Flow Geometry at Straight Drop Spillways" (791) See Rand, Walter

Clo (1041) of "Synthesis of Rainfall-Intensity-Frequency Regimes" (744) See Hershfield, D. M.

Clo (1041) of "Ground Water Phenomena Related to Basin Recharge" (806) See Baumann, Paul

Clo (1092) of "Tidal Computations in Shallow Water" (714) See Dronkers, J. J.

Clo (1092) of "The Importance of Fluvial Morphology in Hydraulic Engineering" (745) See Lane, E. W.

Clo (1092) of "Minimum Pressures in Rectangular Bends" (747) See McPherson, M. B.

Clo (1092) of "Rainfall Depth-Duration Relationships" (840) See Corn, Herbert M.

"Coagulation and Sedimentation" (1052) by J. M. DallaValle

"Design of Stable Canals and Channels in Erodible Material" (880) by Pete W. Terrell and Whitney M. Borland

"Design of Venturi Flumes in Circular Conduits" (928) by Edwin A. Wells and Harold B. Gotaas

Dsc (881) of "A More Simplified Venturi Tube" (678) See Stevens, J. C.

Dsc (881) of "Tidal Currents at Inlets in the United States" (716) See Caldwell, Joseph M.

Dsc (881) of "Synthesis of Rainfall Intensity-Frequency Regimes" (744) See Hershfield, David M.

Dsc (881) of "The Importance of Fluvial Morphology in Hydraulic Engineering" (745) See Lane, E. W.

Dsc (955) of "Ground Water Phenomena Related to Basin Recharge" (806) See Baumann, Paul

Dsc (955) of "Extending Streamflow Data" (826) See Langbein, W. B.

Dsc (955) of "Lunar-Cycle Measurement of Estuarine Flows" (836) See Ingerson, Irvin M.

Dsc (955) of "Integrating the Equation of Gradually Varied Flow" (838) See Chow, Ven Te

Dsc (955) of "Rainfall Depth-Duration Relationships" (840) See Corn, Herbert M.

Dsc (1010) of "Lunar-Cycle Measurement of Estuarine Flows" (836) See Ingerson, Irvin M.

Dsc (1010) of "Integrating the Equation of Gradually Varied Flow" (838) See Chow, Ven-Te

Dsc (1041) of "Extending Streamflow Data" (826) See Langbein, W. B.

"Economic Aspects of Flood Plain Zoning" (882) by H. W. Adams

"Evaluating Effects of Land-Use Changes on Sediment Load" (883) by Alfred J. Cooper and Willard M. Snyder

"Flood Plain Aspects of River Planning" (1040) by Anthony M. Lunetta

"Flood Plain Zoning as Supplement to Flood Control" (954) by Emil P. Schuele

"Flood Protection of Canals by Lateral Spillways" (1077) by Harald Tufts

"Fluid Resistance to Cylinders in Accelerated Motion" (1113) by S. Russell Keim

"Free Outlets and Self-Priming Action of Culverts" (1009) by Wen-Hsiung Li and Calvin C. Patterson

"Free-Surface Disturbances Along a Channel Wall" (1005) by Amein M. Amein and Melville S. Priest

"Friction Measurements in Apalachia Tunnel" (1007) by Rex A. Elder

"Geology of Some American Estuarine Harbors" (956) by Parker D. Trask

"Graphical Determination of Water-Surface Profiles" (1114) by Francis F. Escoffier

"Hydraulic Design of the Sandow Pumping Plant" (948) by R. T. Richards, E. T. Keck, and J. Junget

"Measuring Evapotranspiration from Atmospheric Data" (1035) by George S. Benton and Jack Dominitz

"Old River Diversion Control: Hydraulic Requirements" (907) by E. A. Graves

"Principles of Flocculation Related to Water Treatment" (1036) by Paul D. Haney

"Proportional Weirs for Sedimentation Tanks" (1015) by J. C. Stevens

"Research Needs in Sediment Hydraulics" (953) by Enos J. Carlson and Carl R. Miller

"Seven Exploratory Studies in Hydraulics" (1038) by Hunter Rouse

"The Application of Sediment-Transport Mechanics to Stable-Channel Design" (1034) by Emmett M. Laursen

"The Problem of Reservoir Capacity for Long-Term Storage" (1082) by A. Fathy and Aly S. Shukry

"The Use of Statistics in Reservoir Operations" (1008) by Victor A. Koelzer

"Transition Profiles in Non-Uniform Channels" (1006) by Francis F. Escoffier

"Use of Zoning Principles in Flood Plain Regulation" (957) by Joseph I. Perrey

"Visual Accumulation Tube for Size Analysis of Sands" (1004) by B. C. Colby and R. P. Christensen

INDIANA

"Control of Highway Access: Experiences in Indiana" (873) by Carl E. Vogelgesang

IRRIGATION

"Benefits of Water Development Projects" (981) by Earl R. Fogarty

Clo (903) of "Diversion of Canals" (461) See Ismail, Hassan M.

Clo (903) of "Factors Influencing Irrigation in Humid Areas" (462) See Quackenbush, Tyler H.

Clo (1111) of "Water Rights in Humid Areas" (705) See Critchlow, Howard T.

Clo (1111) of "General Aspects of Planned Ground Water Utilization" (706) See Thomas, Robert O.

IRRIGATION

- Clo (111) of "Measurement of Canal Seepage" (728) See Robinson, A. R.
Clo (111) of "Riverbed Degradation Below Large Capacity Reservoirs" (788) See Mostafa, M. Gamal
"Cost Allocation for Multi-Purpose Water Projects" (961) by N. B. Bennett, Jr.
Dsc (903) of "Water Rights in Humid Areas" (705) See Critchlow, Howard T.
Dsc (982) of "Riverbed Degradation Below Large Capacity Reservoirs" (788) See Mostafa, M. Gamal
"Evaporation from Free Water Surfaces at High Altitudes" (1104) by Harry F. Blaney
"Irrigation Requirements Based on Climatic Data" (1105) by George H. Hargreaves
"Measuring Evapotranspiration from Atmospheric Data (1035) by George S. Benton and Jack Dominitz
"Methods of Determining Consumptive Use of Water in Irrigation" (884) by R. D. Goodrich
"Safe Yield" in Ground-Water Development, Reality or Illusion? (1103) by Raphael G. Kazmann
"The Peoria Recharge Pit: Its Development and Results" (1102) by Max Suter

ITALY

- "Arch Dams: Development in Italy" (1017) by Carlo Semenza
"Arch Dams: Isolato Double-Curvature Arch Dam" (995) by Claudio Marcello
"Arch Dams: Measurements and Studies on Santa Giustina Dam" (993) by Claudio Marcello
"Arch Dams: Rio Freddo Dam with Gravity Abutments and Cut-offs" (996) by Claudio Marcello
"Arch Dams: Santa Giustina Single-Curvature Arch Dam" (992) by Claudio Marcello
"Arch Dams: The Reno Di Lei Double-Curvature Arch Dam" (994) by Claudio Marcello

JAPAN

- "Arch Dams: Design of the Kamishiba Arch Dam" (1018) by C. C. Bonin and H. W. Stuber

JOINTS

- "Effect of Bearing Ratio on Static Strength of Riveted Joints" (1108) by Jonathan Jones

KANSAS

- "Flood Protection at Wichita and Valley Center, Kan." (966) by Myron W. DeGeer

KENTUCKY

- "Lower Cumberland Project: Kentucky and Tennessee" (1062) by Albert E. Dykes

LEVEES

- "Control of Underseepage, Mississippi River Levees, St. Louis District" (864) by C. I. Mansur and R. I. Kaufman

LOADING

- "The Dynamic Response of Tall Structures to Lateral Loads" (944) by L. Schenker

LOCKS

- "New Locks on Lower Mississippi and Gulf Coast" (969) by Norman R. Moore

MAPPING

- "Coordinated Surveying and Mapping for Industry" (1064) by E. D. Morse
Rt "Professional Aspects of Surveying and Mapping: Report of the Task Committee on the Status of Surveying and Mapping" (921) B. Austin Barry, Chmn
"Progress in Topographic Mapping from 1946 to 1955" (922) by Gerald FitzGerald
"Surveying and Mapping for the Air Force Academy" (923) by Edward A. Merrill
"The Use of Photogrammetry to Civil Engineers" (1118) by William O. Baker

MEXICO

- "Control of Rio Grande by United States and Mexico" (975) by J. C. Bustamante and J. F. Friedkin
"Heavy and Tall Building Problems in Mexico City" (917) by Leonardo Zeevaert

MISSISSIPPI

- "The Harrison County Artificial Beach" (1060) by F. F. Escoffier

MISSOURI

- "Control of Underseepage, Mississippi River Levees, St. Louis District" (864) by C. I. Mansur and R. I. Kaufman

MODELS

- "A Direct Method for Model Analysis" (869) by Norbert E. Landeck
"Moment Distribution Constants from Models" (1058) by Otakar Ondra

NEW YORK

- "Control of Highway Access: Experiences in New York" (871) by B. D. Tallamy

PAVEMENTS

- "The Design of Non-Rigid Overlays for Concrete Airfield Pavements" (979) by Frank M. Mellinger and James P. Sale

PIPELINES

- "Stresses in Pressure Pipelines and Protective Casing Pipes" (1054) by M. G. Spangior

POLLUTIONS

- "Pollution of Los Angeles and Long Beach Harbors" (891) by Linne C. Larson

PORTUGAL

- "Arch Dams: Design and Observation of Arch Dams in Portugal" (997) by M. Rocha, J. Laginha Serafim, and A. F. da Silveira
"Arch Dams: Portuguese Experience with Overflow Arch Dams" (990) by A. C. Xerez

POWER

- "Arch Dams: Design and Construction of Ross Dam" (1045) by C. E. Shevling and L. R. Scrivener
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POWER

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Clo (1046) of "Permeability, Pore Pressure and Uplift in Gravity Dams" (700) See Carlson, Roy W.

Clo (1046) of "Morro Bay Steam Electric Plant" (737) See Thon, J. George

Clo (1094) of "Hydraulic Pressure in Concrete" (742) See Powers, T. C.

Clo (1094) of "Model Tests, Analytical Computation and Observation of an Arch Dam," (904) See Rocha, M.

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Dsc (904) of "Selection of Installed Capacity at Hydroelectric Power Plants" (697) See Wing, Leshner S.

Dsc (904) of "Permeability, Pore Pressure and Uplift in Gravity Dams" (700) See Carlson, Roy W.

Dsc (904) of "Morro Bay Steam Electric Plant" (737) See Thon, J. George

Dsc (904) of "Principles of Federal Hydroelectric Power Development" (739) See Whipple, William, Jr.

Dsc (904) of "Theory for the Design of Underground Pressure Conduits" (741) See Bleifuss, D. J.

Dsc (904) of "Hydraulic Pressure in Concrete" (742) See Powers, T. C.

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REPORT

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REPORTS

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RIVERS

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SANITARY ENGINEERING

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- Clo (905) of "Corrosion and Corrosion Research" (685) See Camp, Thomas R.
- Clo (932) of "Sand Filtration Studies with Radiotracers" (592) See Stanley, Donald R.
- Clo (932) to "Photosynthesis in Sewage Treatment" (686) See Oswald, William J.
- Clo (1003) of "Fundamental Concepts of Rectangular Settling Tanks" (590) See Ingersoll, Alfred C.
- Clo (1003) of "Sanitary Engineers—Their Earnings and Professional Attitudes" (773) See Bumstead, John C.
- Clo (1048) of "Sedimentation in Rectangular Basins" (687) See Fischerstrom, Claes N. H.
- Clo (1048) of "A Preliminary Study of High-Rate Composting" (846) See Wiley, John S.
- Clo (1129) of "Experience with a New Type of Dairy Waste" (847) See Nemerow, Nelson L.
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SANITARY ENGINEERING

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SEDIMENTATION

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SHELLS

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SOIL MECHANICS

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Clo (1028) of "Field Vane Shear Tests of Sensitive Cohesive Soils" (755) See Gray, Hamilton

Clo (1095) of "Seepage Forces in a Gravity Dam" by Electrical Analogy" (757) See Johnson, Horace A.

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STRUCTURAL ENGINEERING

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Clo (878) of "Continuous Prestressing" (765). See Moorman, Robert B. B.

Clo (924) of "Frequency of Maximum Wind Speeds" (539) See Thom, H. C. S.

Clo (924) of "Analysis of the Vierendeel Girder by Balancing the Panel Moments" (560) See Diwan, A. F.

Clo (924) of "The Constant Segment Method for the Analysis of Non-Uniform Structural Members" (649) See Hanson, Walter E.

Clo (924) of "A Study of the Behavior of Large I-Section Connections" (659) See Fuller, J. R.

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Clo (924) of "Economy and Safety of Different Types of Concrete Dams" (684) See Komendant, August E.

Clo (972) of "Bending Interaction in Suspension Bridges" (652) See Miklofsky, Haaren A.

Clo (972) of "Foundation Failures in Residences and Small Structures" (561) See Taylor, Karl V.

Clo (972) of "Multiple Span Gabled Frames" (586) See Griffiths, John D.

Clo (985) of "The Highway Spiral for Combining Curves of Different Radii" (703) See Hartman, Paul

Clo (1024) of "High Strength Steel Bolts in Structural Practice" (651). See Bell, Mace H.

Clo (1024) of "Influence Lines for Moment and Shear in a Continuous Beams" (734) See Hoadley, Anthony

Clo (1024) of "Tightening High-Strength Bolts" (786) See Drew, F. P.

Clo (1067) of "Natural Frequencies of Continuous Flexural Members" (735) See Veletso, A. S.

Clo (1067) of "Sequence Summation Factors" (763) See Pauw, Adrian

Clo (1112) of "Analysis of Arches by Finite Differences" (829) See Hirsch, Ephraim G.

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Dsc (878) of "Influence Lines for Moment and Shear in a Continuous Beam" (734) See Hoadley, Anthony

Dsc (878) of "Investigation of Floorbeam Hangers in Railroad Trusses" (762) See Sandberg, C. H.

STRUCTURAL ENGINEERING

- Dsc (878) of "Sequence Summation Factors" (763) See Pauw, Adrian
- Dsc (924) of "Sequence Summation Factors" (763) See Pauw, Adrian
- Dsc (878) of "Plastic Strength of Steel Frames" (764) See Beedle, Lynn S.
- Dsc (878) of "Tightening High-Strength Bolts" (786) See Drew, F. P.
- Dsc (878) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809) See Corning, Leo H.
- Dsc (878) of "Introduction to Semi-Rigid Determinate Polygonal Trusses" (828) See Kenigsberg, Alexander H.
- Dsc (924) of "Plastic Strength of Steel Frames" (764) See Beedle, Lynn S.
- Dsc (924) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809) See Corning, Leo H.
- Dsc (972) of "Sequence Summation Factors" (763) See Pauw, Adrian
- Dsc (972) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809) See Corning, Leo H.
- Dsc (972) of "Determining Basic Wind Loads" (825) See Collins, George F.
- Dsc (972) of "Introduction to Semi-Rigid Determinate Polygonal Trusses" (828) See Kenigsberg, Alexander H.
- Dsc (972) of "Analysis of Arches by Finite Differences" (829) See Hirsch, Ephraim G.
- Dsc (972) of "Load Test of a Diagonally Sheathed Timber Building" (830) See English, J. M.
- Dsc (972) of "Elasti-Plastic Design of Single-Span Beams and Frames" (851) See Sawyer, Herbert A.
- Dsc (1024) of "Elasti-Plastic Design of Single-Span Beams and Frames" (851) See Sawyer, Herbert A. Jr.
- "Dynamic Stresses in Continuous Plate Girder Bridges" (973) by Roy C. Edgerton and Gordon W. Beecroft
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SURVEYING

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SWEDEN

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TANKS

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TENNESSEE

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TEXAS

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TEXAS

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TRANSPORTATION

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TRUSSES

- "Influence Lines for Reactions of Continuous Trusses" (914) by Andrew John Pyka
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TUNNELS

- "Friction Measurements in Apalachia Tunnel" (1007) by Rex A. Elder

VIRGINIA

- "Sand By-Passing at a Virginia Tidal Inlet" (976) by Thomas J. McDonald and Myron A. Sturgeon

WATER SUPPLIES

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WATERWAYS

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"Bridge Clearances: The Operator's View" (938) by N. L. Caruthers

- Clo (913) of "Development of the Delaware River for Commerce" (503) See Talley, B. B.
- Clo (913) of "Graphic Design of Alluvial Channels" (811) See Chien, Ning
- Clo (913) of "River Surveys in Unmapped Territory" (612) See Matthes, Gerard H.
- Clo (1068) of "The Design of Piers, Jetties, and Dolphins" (727) See Hopkins, David A.
- Clo (1068) of "Control of Arroyo Floods at Albuquerque, New Mexico" (801) See Carter, Rufus H. Jr.
- Clo (1068) of "Flood Control in the Middle Mississippi" (803) See Lawlor, Walter F.
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- Dsc (913) of "Flood Control in the Middle Mississippi" (803) See Lawlor, Walter F.
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- "Old River Diversion Control: Foundation Design" (908) by W. J. Turnbull and W. G. Shockley
- "Old River Diversion Control: Hydraulic Requirements" (907) by E. A. Graves
- "Old River Diversion Control: Structures Required" (909) by Norman R. Moore
- "Old River Diversion Control: The General Problem" (906) by John R. Hardin
- "Sand By-Passing at a Virginia Tidal Inlet" (976) by Thomas J. McDonald and Myron A. Sturgeon
- "The Apalachicola River Basin Project" (1120) by C. P. Lindner
- "The Design Wave in Shallow Water" (910) by R. L. Wiegel and K. E. Beebe
- "The Development of the Cumberland River Basin" (1121) by Frank P. Gaines and John T. Dennison

WATERWAYS

- "The Harrison County Artificial Beach" (1060)
by F. F. Escoffier
"Trinity River Flood Control Project" (927) by
James A. Cotton and W. E. Wood
"Water Resources and Power Studies, Task
Force, Hoover Commission: Improvements to
Navigation" (901) by Carey H. Brown

WAVES

- "A Ripple Tank Study of Wave Refraction"
(911) by G. C. Ralls, Jr.
"Design Problems Involved in Protection from
Tsunamis" (968) by Kenneth Kaplan
"Destruction of Wave Energy by Vertical
Walls" (912) by Per Bruun
"The Design Wave in Shallow Water" (910) by
R. L. Wiegel and K. E. Beebe
"Wave Run-Up on Shore Structures" (925) by
Thorndike Saville, Jr.

Author Index

- ABELES, P. W.**
Dsc (972) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (309)
- ADAMS, C. H.**
"Plastics: Engineering Materials" (1072)
- ADAMS, H. W.**
"Economic Aspects of Flood Plain Zoning" (882)
- ALBERTSON, M. L.**
Dsc (982) with H. K. Liu of "Riverbed Degradation Below Large Capacity Reservoirs" (788)
- ALEXANDER, J. C.**
Dsc (903) of "Water Rights in Humid Areas" (705)
- ALLEN, GEARY M., JR.**
Dsc (913) of "Control of Arroyo Floods at Albuquerque, New Mexico" (801)
- ALTER, AMOS J.**
See Clark, Lloyd K. (931)
- AMBERG, HERMAN R.**
"Intermittent Discharge of Spent Sulfite Liquor" (929) with Robert Elder
- AMBRASEYS, N. N.**
Dsc (1091) of "The Viscous Sublayer Along a Smooth Boundary" (945)
Dsc (1095) of "Earthquake Resistance of Rock-Fill Dams" (941)
- AMEIN, AMEIN M.**
"Free-Surface Disturbances Along a Channel Wall" (1005) with Melville S. Priest
Corr (1131) with Melville S. Priest of "Free-Surface Disturbances Along a Channel Wall" (1005)
- ANDERSON, GRANT S.**
Dsc (902) of "Airfield Pavement Design of the Corps of Engineers" (458)
- ARCHIBALD, GEORGE E.**
See Wallace, William (896)
- ASSOCIACAO BRASILEIRA DE CIMENTO PORTLAND**
Dsc (924) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)
- BAILEY, S. M.**
"Local Flood-Protection Projects, Ohio River Basin" (1128) with R. E. Karlen and Harry Pockras
- BAINES, W. DOUGLAS**
Dsc (881) of "Tidal Currents at Inlets in the United States" (716)
- BAKER, WILLIAM O.**
"The Use of Photogrammetry to Civil Engineers" (1118)
- BARBER, EDWARD S.**
Dsc (1028) of "Rupture Surfaces in Sand Under Oblique Loads" (861)
- BARNOFF, ROBERT M.**
"Simplified Analysis of Rigid Frames" (1106)
- BARRY, B. AUSTIN**
Rt "Professional Aspects of Surveying and Mapping: Report of the Task Committee on the Status of Surveying and Mapping" (921)
Dsc of 921: Sumner B. Irish and William A. White (1066)
- BAUMANN, PAUL**
Dsc of 808: Norman H. Brooks, Frederick L. Hotes, James A. Harder, Charles H. Lee, and Robert T. Knapp (955)
Clo (1041) of "Ground Water Phenomena Related to Basin Recharge" (306)
- BEEBE, K. E.**
See Wiegel, R. L. (910)
- BEECROFT, GORDON W.**
See Edgerton, Roy C. (973)
- BEEDELE, LYNN S.**
Dsc of 764: Jack R. Benjamin (873)
Dsc of 764: Zdenek Sobotka (924)
Dsc (1024) of "Elasti-Plastic Design of Single-Span Beams and Frames" (851)
- BELL, MACE H.**
Clo (1024) of "High Strength Steel Bolts in Structural Practice" (651)
- BELL, MILO C.**
Dsc (1046) of "Fish Passage Facilities at McNary Dam" (895)
- BELMONT, D. M.**
"A Pattern of Interstation Airline Travel" (987)
Corr (1110) of "A Pattern of Interstation Airline Travel" (987)
- BENJAMIN, JACK R.**
Dsc (878) of "Plastic Strength of Steel Frames" (784)
Dsc (878) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)
- BENNETT, N. B., JR.**
"Cost Allocation for Multi-Purpose Water Projects" (961)
Dsc of 961: Frederick L. Hotes; Wendell E. Johnson and Charles A. Cocks; Eugene W. Weber (1111)
- BENTON, GEORGE S.**
"Measuring Evapotranspiration from Atmospheric Data" (1035) with Jack Dominitz
- BERG, GLEN V.**
Dsc (878) of "Introduction to Semi-Rigid Determinate Polygonal Trusses" (828)

- BERG, PAUL H.**
Dsc (903) of "Water Rights in Humid Areas" (705)
- BERINDOAGUE, GEORGE J.**
See Schacherl, Robert D. (877)
- BETHURUM, G. R., JR.**
See Dorland, G. M. (1061)
- BLAISDELL, FRED W.**
Dsc (1131) of "Free Outlets and Self-Priming Action of Culverts" (1009)
- BLANEY, HARRY F.**
"Evaporation from Free Water Surfaces at High Altitudes" (1104)
- BLATT, JOSEPH D.**
"What Is the Story of Aviation Today?" (980)
- BLEIFUSS, D. J.**
Dsc of 741: Evan W. Vaughan; Stavros N. Nicolaou; Wm. Reid Martin, Jr., and Jan A. Veitrop; M. L. Pei (904)
Clo (1011) of "Theory for the Design of Underground Pressure Conduits" (741)
Clo (1028) of "Rock-Fill Dam Design and Construction Problems" (514) with James P. Hawke
- BLENCH, THOMAS**
Clo (881) of "Scale Relations among Sand-Bed Rivers Including Models" (667)
- BLOODGOOD, D. E.**
"Sedimentation Studies" (1083) with W. J. Boegly and C. E. Smith
- BLTYHE, DAVID K.**
"Uses of Aerial Surveying in Highway Design and Location" (1065)
- BOCK, ROBERT O.**
See Zee, Chong-Hung (1091)
- BOEGLY, W. J.**
See Bloodgood, D. E. (1083)
- BOGDANOFF, JOHN L.**
See Goldberg, John E. (943)
- BONIN, C. C.**
"Arch Dams: Design of the Kamishiiba Arch Dam" (1018) with H. W. Stuber
- BORGER, J. G.**
Clo (902) of "Jet Transport Economics—Influence on Airport and Airway" (241)
- BORGES, J. FERRY**
Dsc (1024) of "A Direct Method for Model Analysis" (869)
- BORLAND, WHITNEY M.**
Dsc (903) with C. R. Miller of "Riverbed Degradation Below Large Capacity Reservoirs" (788)
See Terrell, Pete W. (880)
- BRADLEY, JOSEPH N.**
See Izzard, Carl F. (877)
- BRANT, AUSTIN E.**
Dsc (1124) of "Developing Port Facilities on Houston's Ship Channel" (965)
- BRESLER, BORIS**
Dsc of 674: Henry J. Cowan (876)
Clo (876) of "Failure of Plain Concrete under Combined Stresses" (674) with Karl S. Pister
- BROOKS, NORMAN H.**
Dsc (955) of "Ground Water Phenomena Related to Basin Recharge" (806)
See Ingersoll, Alfred C. (1003)
- BROWN, CAREY H.**
"Water Resources and Power Studies, Task Force, Hoover Commission: Improvements to Navigation" (901)
- BROWN, WALTER A.**
Dsc (1028) of "Basic Concepts on the Compaction of Soils" (862)
- BROWNFIELD, A. H.**
Dsc (985) of "The Highway Spiral for Combining Curves of Different Radii" (703)
- BRUDENELL, ROSS N.**
Dsc (904) of "Principles of Federal Hydroelectric Power Development" (739)
- BRUMER, MILTON**
"Development and Design of the Walt Whitman Bridge" (1019) with C. W. Hanson
Dsc of 1019: Cevdet Z. Erzen
Corr (1112) with C. W. Hanson of "Development and Design of the Walt Whitman Bridge" (1019)
- BRUUN, PER**
"Destruction of Wave Energy by Vertical Walls" (912)
- BUCKLEY, JAMES C.**
"The Effect of Airport Distance on Traffic Generation" (978)
- BUDGEN, H. P.**
Dsc (87F) of "Tightening High-Strength Bolts" (786)
- BUETTNER, CHARLES E.**
Clo (1130) with Paul A. Pickel of "The High-Syphon Circulating Water System—Meramec Plant" (740)
- BUMSTEAD, JOHN C.**
Dsc of 773: Ross E. McKinney (1003)
Clo (1003) of "Sanitary Engineers—Their Earnings and Professional Attitudes" (773)
- BURGRABBE, FRANK L.**
See Shelton, Ralph L. (1133)
- BUSBY, C. E.**
Dsc (903) of "Water Rights in Humid Areas" (705)
- BUSTAMANTE, J. C.**
"Control of Rio Grande by United States and Mexico" (975) with J. F. Friedkin
Corr (1124) with J. F. Friedkin of "Control of Rio Grande by United States and Mexico" (975)

- BUTLER, ROBERT G.**
See Orllob, Gerald T. (1002)
- CALAHAN, PECOS H.**
Dsc (985) of "Using Consultants to Expand a Highway Program" (824)
- CALDWELL, JOSEPH M.**
Dsc of 716: W. Douglas Baines (881)
- CAMP, THOMAS R.**
Clo (905) of "Corrosion and Corrosion Research" (685)
- CARLSON, ENOS J.**
"Research Needs in Sediment Hydraulics" (953)
with Carl R. Miller
Dsc of 953: Arthur L. McCutchan; Sam Shults (1092)
- CARLSON, ROY W.**
Dsc of 700: J. Laginha Serafim (904)
Dsc of 700: Serge Leliavsky (952)
Clo (1046) of "Permeability, Pore Pressure and Uplift in Gravity Dams" (700)
- CARTER, RUFUS H., JR.**
Dsc of 801: Geary M. Allen, Jr. (913)
Clo (1038) of "Control of Arroyo Floods at Albuquerque, New Mexico" (801)
- CARUTHERS, N. L.**
"Bridge Clearances: The Operator's View" (938)
- CASSEN, BENEDICT**
See Dunne, B. B. (919)
- CASTER, ARTHUR D.**
Clo (1003) of "Sanitary Engineers—Their Earnings and Professional Attitudes" (773)
- CAWLEY, W. A.**
"An Improved Dilution Method for Flow Measurements" (1084) with J. W. Woods
- CHAMECKI, SAMUEL**
"Structural Rigidity in Calculating Settlements" (865)
- CHANG, CHIAO-LIN**
Dsc (972) of "Analysis of Arches by Finite Differences" (829)
- CHIEN, NING**
Clo (913) of "Graphic Design of Alluvial Channels" (611)
- CHOLLAR, ALLAN L.**
"Modernizing a Texas Highway with Concrete" (1074)
- CHOW, VEN TE**
Dsc of 838: Clint J. Keifer and Henry Hsien Chu, Robert Y. D. Chun, Masashi Hom-Ma, Allan Newman, and Steponas Kolupalla (955)
Dsc of 838: R. Silvester and Alfred S. Harrison (1010)
Clo (881) of "The Log-Probability Law and its Engineering Applications" (536)
- CHOW, VEN TE**
Corr (955) of "Integrating the Equation of Gradually Varied Flow" (838)
- CHRISTENSEN, R. P.**
See Colby, B. C. (1004)
- CHU, HENRY HSIEN**
See Keifer, Clint J. (955)
- CHUN, ROBERT Y. D.**
Dsc (955) of "Integrating the Equation of Gradually Varied Flow" (838)
- CLAIRE, WILLIAM H.**
"Urban Redevelopment Can Implement Mass Transit" (964)
- CLARK, J. W.**
Rt "Specifications for Structures of Aluminum Alloy 6061-T6: Second Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys" (970)
Rt "Specifications for Structures of Aluminum Alloy 2014-T6: Third Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys" (971)
Corr (1024) of "Specifications for Structures of Aluminum Alloy 6061-T6: Second Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys" (970)
Corr (1024) of "Specifications for Structures of Aluminum Alloy 2014-T6: Third Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys" (971)
- CLARK, LLOYD K.**
"Water Supply in Arctic Areas: Design Features" (931) by Amos J. Alter
- CLEARY, WILLIAM E.**
"Bridge Clearance: Problem Needs Realistic Approach" (937)
- CLENDENEN, FRANK B.**
Dsc (903) of "General Aspects of Planned Ground Water Utilization" (706)
- CLEVINGER, WILLIAM A.**
"Experiences with Loess as Foundation Material" (1025)
- CLOUGH, RAY W.**
"Earthquake Resistance of Rock-Fill Dams" (941) with David Pirtz
Dsc of 941: John V. Spielman; Nicols N. Ambraseys (1095)
- COCKS, CHARLES A.**
See Johnson, Wendell E. (1111)
- COHEN, EDWARD**
Dsc (1067) with Edward Laing of "Arching Action Theory of Masonry Walls" (915)
- COLBY, B. C.**
"Visual Accumulation Tube for Size Analysis of Sands" (1004) with R. P. Christensen
- COLLINS, GEORGE F.**
Dsc of 825: Albert W. Hainlin, T. C. Rathbone (972)

- COLLINS, GEORGE F.**
Corr (924) to "Determining Basic Wind Loads" (825)
- COOK, FRANK B.**
"Design of the Eklutna Project, Alaska" (1132)
with David L. Goodman
- COOPER, ALFRED J.**
"Evaluating Effects of Land-Use Changes on Sediment Load" (883) with Willard M. Snyder
- COPEN, MERLIN D.**
Dsc (904) of "Model Tests, Analytical Computation and Observation of an Arch Dam" (696)
See Glover, R. E. (960)
- CORN, HERBERT M.**
Dsc of 840: D. M. Hershfield and W. T. Wilson (955)
Clo (1092) of "Rainfall Depth-Duration Relationships" (840)
- CORNING, LEO H.**
Dsc of 809: Jack R. Benjamin (878)
Dsc of 809: Ignacio Martin, Associacao Brasileira de Cimento Portland, Harold G. Lorsch, Louis A. North, and Carl F. Long (924)
Dsc of 809: P. W. Abeles, L. W. Mensch (972)
- COTTON, JAMES A.**
"Trinity River Flood Control Project" (927)
with W. E. Wood
- COULTER, J. B.**
"Preliminary Studies on Complete Anaerobic Sewage Treatment" (1089) with S. Soneda and M. B. Ettinger
- COWAN, HENRY J.**
Dsc (876) of "Failure of Plain Concrete under Combined Stresses" (874)
- COYNE, ANDRE**
"Arch Dams: Their Philosophy" (959)
Dsc of 959: G. S. Sarkaria; George E. Goodall (1094)
- CRAIG, FRANKLIN C.**
Dsc (955) of "Lunar-Cycle Measurement of Estuarine Flows" (836)
- CRITCHLOW, HOWARD T.**
Dsc of 705: H. E. Thomas, C. E. Busby, Paul H. Berg, and J. C. Alexander (903)
Clo (1111) of "Water Rights in Humid Areas" (705)
- CURRAN, CHARLES D.**
Dsc (1046) of "Water Resources and Power Studies, Task Force, Hoover Commission: Reclamation and Water Supply" (899)
- DALLAVALLE, J. M.**
"Coagulation and Sedimentation" (1052)
- DA SILVA, A. F.**
See Rocha, M. (997)
- DAVIS, HARMER E.**
"Highway Engineering Manpower: Engineering Education Aspects" (984)
- DE BEER, E.**
Dsc (1095) with A. Martens of "Penetration Tests and Bearing Capacity of Cohesionless Soils" (866)
- DEGEER, MYRON W.**
"Flood Protection at Wichita and Valley Center, Kan." (966)
- DEHART, R. C.**
"Response of a Rigid Frame to a Distributed Transient Load" (1056)
- DENNISON, JOHN T.**
See Gaines, Frank P. (1121)
- DIACHISHIN, ALEX N.**
"The Analysis of Water Samples for Cyclical Variations" (930)
- DICKEY, ROBERT R.**
Dsc (1067) of "Influence Lines for Reactions of Continuous Trusses" (914)
- DITTBRENNER, ERHARD E.**
"Bridge Clearances: Problems in North-eastern United States" (939)
- DIWAN, A. F.**
Clo (924) of "Analysis of the Vierendeel Girder by Balancing the Panel Moments" (560)
- DOBBINS, WILLIAM E.**
See O'Connor, Donald J. (1115)
- DOMINITZ, JACK**
See Benton, George S. (1035)
- DORLAND, G. M.**
"Growth of Commerce: Tennessee and Cumberland Rivers" (1061) with G. R. Bethurum, Jr.
- DREW, F. P.**
Dsc of 786: H. P. Budgen (878)
Dsc of 786: Elmo G. Peterson (878)
Dsc of 786: Manley A. Roose (878)
Clo (1024) of "Tightening High-Strength Bolts" (786)
- DRONKERS, J. J.**
Clo (1092) with J. C. Schonfeld of "Tidal Computations in Shallow Water" (714)
- DRUCKER, D. C.**
Dsc (1125) of "Education of Civil Engineers: Need for Reconsideration" (858)
- DUBOSE, LAWRENCE A.**
Dsc (1028) of "The Action of Soft Clay Along Friction Piles" (842)
- DUNNE, B. B.**
"Behaviour of Shock Waves Entering Model Bomb Shelters" (919) with Benedict Cassen
- DYER, HARRY B.**
"Modern Towboat and Barge Design" (1122)
- DYKES, ALBERT E.**
"Lower Cumberland Project: Kentucky and Tennessee" (1062)

- EDEN, EDWIN W., JR.
"Design of Major Drainage Canals" (962)
- EDGERTON, ROY C.
"Dynamic Stresses in Continuous Plate Girder Bridges" (973) with Gordon W. Beecroft
Dsc of 973: R. K. L. Wen (1112)
- EINSTEIN, H. A.
"The Viscous Sublayer Along a Smooth Boundary" (945) with Huon Li
Dsc of 945: E. Silberman; N. N. Ambraseys (1091)
- ELDER, REX A.
"Friction Measurements in Apalachia Tunnel" (1007)
- ELDER, ROBERT
See Amberg, Herman R. (929)
- ENGLER, HERSHEL
"Engineering Job Opportunities in World Health" (1012)
- ENGLISH, J. M.
Dsc of 830: E. George Stern, Norman B. Jones (972)
- EREMIN, A. A.
Dsc (1067) of "Influence Lines for Reactions of Continuous Trusses" (914)
Dsc (1067) of "Arching Action Theory of Masonry" (915)
Dsc (1095) of "Redriving Characteristics of Piles" (1026)
- ERZEN, CEVDET E.
Dsc (1112) of "Development and Design of the Walt Whitman Bridge" (1019)
- ESCOFFIER, FRANCIS F.
"Graphical Determination of Water-Surface Profiles" (1114)
"The Harrison County Artificial Beach" (1060)
"Transition Profiles in Non-Uniform Channels" (1006)
Dsc of 1006: Achille Lazard (1092)
- ETTINGER, M. B.
See Coulter, J. B. (1089)
- FABER, HARRY A.
"Sanitary Engineering Research—The Role of Research Grants" (1126) with Harvey F. Ludwig and Harry G. Hanson
- FATHY, A.
"The Problem of Reservoir Capacity for Long-Term Storage" (1082) with Aly S. Shukry
- FELD, JACOB
Dsc (904) of "Morro Bay Steam Electric Plant" (737)
- FERGUSON, PHIL M.
"Simplification of Design by Ultimate Strength Procedures" (1022)
- FISCHERSTROM, CLAES N. H.
Dsc of 687: Jack E. McKee (905)
- FISCHERSTROM, CLAES N. H.
Clo (932) of "Sedimentation in Rectangular Basins" (687)
Clo (1048) of "Sedimentation in Rectangular Basins" (687)
- FISHER, LEIGH
"Airport and City Planning" (1109)
- FITZGERALD, GERALD
"Progress in Topographic Mapping from 1946 to 1955" (922)
- FLEMING, JULIAN R.
"Municipal Ordinances for Industrial Wastes" (1085)
- FOCHT, JOHN A., JR.
Dsc (1028) of "Penetration Tests and Bearing Capacity of Cohesionless Soils" (866)
Dsc (1095) of "Stabilization of Materials by Compaction" (934)
See McClelland, Bramlette (1081)
- FOGARTY, EARL R.
"Benefits of Water Development Projects" (981)
- FORESTER, D. M.
Dsc (1111) of "Methods of Determining Consumptive Use of Water in Irrigation" (884)
- FOSTER, CHARLES R.
See Turnbull, W. J. (934)
- FREDERICK, DANIEL
Dsc of 818: Harold G. Lorsch (946)
Clo (1091) of "Thick Rectangular Plates on an Elastic Foundation" (818)
Corr (876) of "Thick Rectangular Plates on an Elastic Foundation" (818)
- FRIEDKIN, J. F.
See Bustamante, J. C. (975)
- FULLER, J. R.
Clo (924) of "A Study of the Behavior of Large I-Section Connections" (659)
- GAINES, FRANK P.
"The Development of the Cumberland River Basin" (1121) with John T. Dennison
- GARNER, J. M. JR.
"Radioactive Sediments in the Tennessee River System" (1051) with Oscar W. Kochtitzky
- GARNER, JAMES
"Sewage Disposal in Sweden" (958)
- GIANGRECO, ELIO
Dsc (972) of "Sequence Summation Factors" (763)
- GIBBS, HAROLD J.
See Holtz, Wesley G. (867)
- GILMAN, ROGER H.
"Transportation Planning: The Port—A Focal Point" (893)

- GLAZBROOK, CHARLES S.
"Earthquake Stresses in Building Floors"
(1098)
- GLOVER, ROBERT E.
"Arch Dams: Trial Load Studies for Hungry Horse Dam" (960) with Merlin D. Copen
Dsc (946) of "Flow into a Well by Electric and Membrane Analogy" (817)
Dsc (1046) of "Theory, Methods and Details of Grouting Contraction Joints in Arch Dams" (991)
Dsc (1130) of "Arch Dams: Design and Observation of Arch Dams in Portugal" (997)
- GLOYNA, EARNEST F.
"Some Design Considerations for Oxidation Ponds" (1047) with Edward R. Hermann
- GOLDBERG, JOHN E.
"Inelastic Buckling of Non-Uniform Columns" (943) with John L. Bogdanoff and Hsu Lo
- GOLZE, ALFRED L.
Dsc (1125) of "Education of Civil Engineers: Training for Civil Engineers" (859)
- GOODALL, GEORGE E.
Dsc (1094) of "Arch Dams: Their Philosophy" (959)
- GOODE, T. B.
See Shockley, W. G. (1080)
- GOODMAN, DAVID L.
See Cook, Frank B. (1132)
- GOODRICH, R. D.
"Methods of Determining Consumptive Use of Water in Irrigation" (884)
Dsc of 884: D. M. Forester (1111)
Dsc (955) of "Extending Streamflow Data" (828)
- GORMAN, ARTHUR E.
"Waste Disposal as Related to Site Selection" (1000)
- GOTAAS, HAROLD B.
See Oswald, William J. (932)
See Wells, Edwin A. (928)
- GRANSTROM, MARVIN L.
Rt "Variation of Point Rainfall with Distance" (888)
- GRAVES, E. A.
"Old River Diversion Control: Hydraulic Requirements" (907)
- GRAY, HAMILTON
Clo (1028) of "Field Vane Shear Tests of Sensitive Cohesive Soils" (755)
- GREER, D. C.
"Control of Highway Access: Economic Effects of the Gulf Freeway" (872)
- GRIFFITH, J. E.
See Marin, Joseph (1029)
- GRIFFITHS, JOHN D.
Clo (972) of "Multiple Span Gabled Frames" (586)
- GRIFFITHS, ROBERT H.
Dsc (985) of "Using Consultants to Expand a Highway Program" (824)
- GRINTER, L. E.
Dsc of 858: D. C. Drucker (1125)
Clo (1125) of "Education of Civil Engineers: Need for Reconsideration" (858)
- HAJLIN, ALBERT W.
Dsc (972) of "Determining Basic Wind Loads" (825)
- HANEY, PAUL D.
"Principles of Flocculation Related to Water Treatment" (1036)
- HANSEN, VAUGHN E.
Dsc (946) of "Flow into a Well by Electric and Membrane Analogy" (817)
- HANSON, C. W.
See Brumer, Milton (1019)
- HANSON, HARRY G.
See Faber, Harry A. (1126)
- HANSON, WALTER E.
Clo (924) with Wallace F. Wiley of "The Constant Segment Method for the Analysis of Non-Uniform Structural Members" (649)
- HAPP, STAFFORD C.
Dsc (955) of "The Importance of Fluvial Morphology in Hydraulic Engineering" (745)
- HARDER, JAMES A.
Dsc (955) of "Ground Water Phenomena Related to Basin Recharge" (806)
- HARDIN, JOHN R.
"Old River Diversion Control: The General Problem" (906)
- HARGREAVES, GEORGE H.
"Irrigation Requirements Based on Climatic Data" (1105)
- HARRISON, ALFRED S.
See Silvester, R. (1010)
- HARMAN, PAUL
"The Highway Spiral as a Centerline for Structures" (1090)
Dsc of 703: C. C. Wiley, A. H. Brownfield (985)
Clo (985) of "The Highway Spiral for Combining Curves of Different Radii" (703)
Corr (1093) to "The Highway Spiral for Combining Curves of Different Radii" (703)
- HAWKE, JAMES P.
See Bleifuss, D. J.
- HEAGY, KENNETH
"Houston, Texas, Floodway" (926) by Kenneth Heagy
- HENDERSON, EDWARD A.
Clo (942) of "Settlement Analysis of Sand Drain Projects" (756)

HENDRICKS, E. L.

Clo (881) of "Surface-Water Supply for Irrigation in the Vermilion River Basin, Louisiana" (489)

HENDRY, ARNOLD W.

"The Load Distribution in Highway Bridge Decks" (1023) with Leslie G. Jaeger

HERMANN, EDWARD R.

See Gloyna, Earnest F. (1047)

HERSHFIELD, DAVID M.

Dsc of 744: William H. Sammons (881)

Clo (1041) with L. L. Weiss and W. T. Wilson of "Synthesis of Rainfall-Intensity-Frequency Regimes" (744)

Dsc (955) with W. T. Wilson of "Rainfall Depth-Duration Relationships" (840)

HILL, KENNETH V.

"Knoxville Sewage Treatment Plant" (1127)

HIRASHIMA, K. B.

Dsc (1095) of "Stabilization of Materials by Compaction" (934)

HIRSCH, EPHRAIM G.

Dsc of 829: Chiao-Lin Chang, Herbert A. Sawyer, Jr. (972)

Clo (1112) with E. P. Popov of "Analysis of Arches by Finite Differences" (829)

HOADLEY, ANTHONY

Dsc of 734: J. J. Polivka (878)

Clo (1024) of "Influence Lines for Moment and Shear in a Continuous Beam" (734)

HOLDEN, FRANCIS W.

Dsc (985) of "Using Consultants to Expand a Highway Program" (824)

HOLTZ, WESLEY G.

"Triaxial Shear Tests on Pervious Gravelly Soils" (867) with Harold J. Gibbs

HOM-MA, MASACHI

Dsc (955) of "Integrating the Equation of Gradually Varied Flow" (838)

HOPKINS, DAVID A.

Dsc of 727: Zusse Levinton (913)

Clo (1068) of "The Design of Piers, Jetties, and Dolphins" (727)

Dsc (1095) of "Thrust Loading on Piles" (940)

HORNER, W. W.

"Water Resources and Power Studies, Task Force, Hoover Commission: Flood Control" (900)

HORONJEFF, ROBERT

Dsc of 720: Roger H. Williams, J. F. Redus (902)

Clo (1110) with John Hugh Jones of "The Effect of Traffic Upon Runway Pavement Cross-Section" (720)

HOTES, FREDERICK L.

Dsc (955) of "Ground Water Phenomena Related to Basin Recharge" (806)

HOTES, FREDERICK L.

Dsc (1111) of "Cost-Allocation for Multi-Purpose Water Projects" (961)

HOUSNER, G. W.

Dsc (1091) of "Suppression of the Fluid-Induced Vibration of Circular Cylinders" (1030)

HOWELL, HERBERT H.

"The New Federal-Aid Airport Program" (989)

HRENNIKOFF, A.

Dsc (904) of "Hydraulic Pressure in Concrete" (742)

HUGGINS, MARK W.

"Moments in Flat Slabs" (1020) with Watone L. Lin

HYLAND, SUMNER G.

Dsc (1028) of "Penetration Tests and Bearing Capacity of Cohesionless Soils" (866)

INGERSOLL, ALFRED C.

Clo (1003) with Jack E. McKee and Norman H. Brooks of "Fundamental Concepts of Rectangular Settling Tanks" (590)

INGERSON, IRVIN M.

Dsc of 836: Franklin C. Craig, and L. J. Tison (955)

Dsc of 836: John A. Roberson (1010)

INGRAM, WILLIAM T.

"A New Approach to Trickling Filter Design" (999)

IRISH, SUMNER B.

Dsc (1066) of "Professional Aspects of Surveying and Mapping" (921)

ISMAIL, HASSAN M.

Clo (903) of "Diversion of Canals" (461)

IZZARD, CARL F.

Dsc (877) with Joseph N. Bradley of "Flood-Erosion Protection for Highway Fills" (783)

JAEGER, LESLIE G.

See Hendry, Arnold W. (1023)

JIRGAL, JOHN

"Water Resources and Power Studies, Task Force, Hoover Commission: Power Generation and Distribution" (898)

JOHNSON, F. A.

Dsc (1041) of "Extending Streamflow Data" (826)

JOHNSON, HORACE A.

Dsc of 757: Serge Lellavsky (942)

Clo (1095) of "Seepage Forces in a Gravity Dam by Electrical Analogy" (757)

JOHNSON, L. F.

See Lindner, C. P.

JOHNSON, REUBEN J.

"Alternatives to Stone in Breakwater Construction" (1059) with Olin F. Weymouth

- JOHNSON, WENDELL E.
Dsc (1111) with Charles A. Cocks of "Cost-Allocation for Multi-Purpose Water Projects" (961)
- JOHNSTON, BRUCE G.
Clo (946) with Archie Mathews of "Blast-Resistant Building Frames" (695)
Dsc (972) of "Elasti-Plastic Design of Single-Span Beams and Frames" (851)
- JONES, JOHN HUGH
See Horonjeff, Robert (1110)
- JONES, JONATHAN
"Effect of Bearing Ratio on Static Strength of Riveted Joints" (1108)
- JONES, NORMAN B.
Dsc (972) of "Load Test of a Diagonally Sheathed Timber Building" (830)
- JCRDY, GEORGE L.
Dsc (904) of "Morro Bay Steam Electric Plant" (737)
- JORISSEN, ANDRE L.
"A New Development in Flow Measurement: The Dall Flow Tube" (1039)
- JUMIKIS, ALFRED S.
"Rupture Surfaces in Sand under Oblique Loads" (861)
Dsc of 861: G. G. Meyerhof, Edward S. Barber (1028)
- JUNGET, J.
See Richards, R. T. (948)
- KAPLAN, KENNETH
"Design Problems Involved in Protection from Tsunamis" (968)
- KARLEN, R. E.
See Bailey, S. M. (1128)
- KAROL, JACOB
Dsc (1067) of "Influence Lines for Reactions of Continuous Trusses" (914)
- KAUFMAN, R. L.
See Mansur, C. I. (864)
See Mansur, C. I. (1079)
See Turnbull, W. J. (1028)
- KAWATA, KAZUYOSHI
Dsc (1048) of "Sanitary Engineering Programs of the L.C.A. in the N.E.A. Area" (885)
- KAZMANN, RAPHAEL G.
"Safe Yield' in Ground-Water Development, Reality or Illusion?" (1103)
- KECK, E. T.
See Richards, R. T. (948)
- KEIFER, CLINT J.
Dsc (955) with Henry Hsien Chu of "Integrating the Equation of Gradually Varied Flow" (838)
- KEIM, S. RUSSELL
"Fluid Resistance to Cylinders in Accelerated Motion" (1113)
- KENIGSBERG, ALEXANDER H.
"Anchorages for Large Tainter Gates" (1119)
Dsc of 828: Glen V. Berg (878)
Dsc of 828: E. Neil W. Lane, A. C. Scordelis (972)
- KERR, S. LOGAN
Dsc (952) of "Hydraulic Design of the Sandow Pumping Plant" (948)
- KETTER, ROBERT L.
Dsc (1024) of "Elasti-Plastic Design of Single-Span Beams and Frames" (851)
- KIKER, JOHN E.
"New Developments in Septic Tank Systems" (1088)
- KINDSVATER, CARL E.
Dsc (985) of "Flood-Erosion Protection for Highway Fills" (783)
- KLINE, GORDON M.
"Plastics" (1071)
- KNAPP, ROBERT T.
Dsc (955) of "Ground Water Phenomena Related to Basin Recharge" (806)
- KOCHTITSKY, OSCAR W.
See Garner, J. M. Jr. (1051)
- KOELZER, VICTOR A.
"The Use of Statistics in Reservoir Operations" (1008)
- KOLUPAILA, STEPONAS
Dsc (955) of "Integrating the Equation of Gradually Varied Flow" (838)
- KOMENDANT, AUGUST E.
Clo (924) of "Economy and Safety of Different Types of Concrete Dams" (884)
- KRAFFT, ROBERT F.
Dsc (904) of "Selection of Installed Capacity at Hydroelectric Power Plants" (697)
- KRIGE, P. R.
Dsc (1048) of "A Preliminary Study of High-Rate Composting" (846)
- KUIPER, E.
Dsc (881) of "The Importance of Fluvial Morphology in Hydraulic Engineering" (745)
Dsc (913) of "Flood Control in the Middle Mississippi" (803)
- KURYLO, WALTER
"Bridge Clearances: The Interest of Bureau of Public Roads" (936)
- LAIL, WILLIAM F.
See Michiels, Charles F. (1123)
- LAING, EDWARD
See Cohen, Edward (1067)

LAMOUREUX, VINCENT B.

"Sanitary Engineering Programs of the I.C.A. in the N.E.A. Area" (885)

Dsc of 885: A. Streiff (1003)

Dsc of 885: Kazuyoshi Kawata (1048)

LANDDECK, NORBERT E.

"A Direct Method for Model Analysis" (869)

Dsc of 869: J. Ferry Borges (1024)

LANE, E. W.

Dsc of 745: E. Kuiper, W.H.R. Nimmo (881)

Dsc of 745: Stafford C. Happ (955)

Clo (1092) of "The Importance of Fluvial Morphology in Hydraulic Engineering" (745)

Dsc (877) of "Flood-Erosion Protection for Highway Fills (783)

Dsc (972) of "Introduction to Semi-Rigid Determine Polygonal Trusses" (828)

LANGBEIN, W. B.

Dsc of 826: R. D. Goodrich, Carroll F.

Merriam and E. T. Schuleen, and Willard M. Snyder (955)

Dsc of 955: F. A. Johnson (1041)

LANTZ, ERSEL G.

Dsc (1124) of "Developing Port Facilities on Houston's Ship Channel" (965)

LARSON, LINNE C.

"Pollution of Los Angeles and Long Beach Harbors" (891)

LAURITZEN, C. W.

Dsc (903) of "Measurement of Canal Seepage" (728)

LAURSEN, EMMETT M.

"The Application of Sediment-Transport Mechanics to Stable-Channel Design" (1034)

LAWLOR, WALTER F.

Dsc of 803: E. Kuiper (913)

Clo (1068) of "Flood Control in the Middle Mississippi" (803)

LAWRENCE, RAY E.

"Planning Sewerage Services for Suburban Areas" (892)

Dsc of 892: George W. Reid (1003)

LAZARD, ACHILLE

Dsc (1092) of "Transition Profiles in Non-Uniform Channels" (1006)

LEAHEY, T. F.

See Fuller, J. R. (924)

LEE, CHARLES H.

Dsc (955) of "Ground Water Phenomena Related to Basin Recharge" (806)

LELIAVSKY, SERGE

Dsc (903) of "Riverbed Degradation Below Large Capacity Reservoirs" (788)

Dsc (904) of "Hydraulic Pressure in Concrete" (742)

Dsc (942) of "Seepage Forces in a Gravity Dam by Electrical Analogy" (757)

Dsc (952) of "Permeability, Pore Pressure and Uplift in Gravity Dams" (700)

LEONARDS, G. A.

Dsc (1095) of "Stabilization of Materials by Compaction" (934)

LEVINTON, ZUSSE

Dsc (913) of "The Design of Piers, Jetties, and Dolphins" (727)

LEWIS, H. E.

See Morice, P. B. (1055)

LI, C. Y.

"Basic Concepts on the Compaction of Soil" (862)

LI, C. Y.

Dsc of 862: E. J. Zagarra, Walter A. Brown (1028)

Clo (1095) of "Basic Concepts on the Compaction of Soils" (862)

LI, HUON

See Einstein, H. A. (945)

LI, WEN-HSIUNG

"Analysis of a Skew Diversion" (868)

"Free Outlets and Self-Priming Action of Culverts" (1009) with Calvin C. Patterson

Dsc of 1009: Fred W. Blaisdell (1131)

Corr (985) of "Analysis of a Skew Diversion" (868)

LIN, T. Y.

"Cable Friction in Post-Tensioning" (1107)

LIN, WATONE L.

See Huggins, Mark W. (1020)

LINDNER, C. P.

"Hydro-Electric Power in the Southeast" (1086)

with L. F. Johnson

"The Apalachicola River Basin Project" (1120)

LIU, H. K.

See Albertson, M. L. (982)

LO, HSU

See Goldberg, John E. (943)

LONG, CARL F.

Dsc (924) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)

LORSCH, HAROLD G.

Dsc (924) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)

Dsc (946) of "Thick Rectangular Plates on an Elastic Foundation" (818)

LUDWIG, HARVEY F.

See Faber, Harry A. (1126)

LUMMIS, HENRY M. III

"Influence Lines for Circular Ring Redundants" (1097)

LUNETTA, ANTHONY M.

"Flood Plain Aspects of River Planning" (1040)

- LUNETTA, ANTHONY**
Dsc (1040): Robert L. Smith (1041)
- LUNN, OTTO R.**
"McNary Dam—Coordination of Project Design and Construction" (951)
- LUTHIN, JAMES N.**
Dsc (946) of "Flow into a Well by Electric and Membrane Analogy" (817)
- MACLEAN, BERTON M.**
See Von Gunten, Glenn H. (895)
- MANSUR, C. I.**
"Control of Underseepage, Mississippi River Levees, St. Louis District" (864) with R. L. Kaufman
"Pile Tests, Low-Sill Structure, Old River, La." (1079) with R. L. Kaufman
- MARCELLO, CLAUDIO**
"Arch Dams: Isolato Double-Curvature Arch Dam" (995)
"Arch Dams: Measurements and Studies on Santa Giustina Dam" (993)
"Arch Dams: Rio Freddo Dam with Gravity Abutments and Cut-offs" (996)
"Arch Dams: Santa Giustina Single-Curvature Arch Dam" (992)
"Arch Dams: The Reno Di Lei Double-Curvature Arch Dam" (994)
- MARIN, JOSEPH**
"Creep Relaxation of Plexiglass IIA for Simple Stresses" (1029) with J. E. Griffith
- MARSH, BURTON W.**
"Transportation Planning: Prospects for Coordination" (988)
- MARTENS, A.**
See De Beer, E. (1095)
- MARTIN, HAROLD C.**
"Truss Analysis by Stiffness Considerations" (1070)
- MARTIN, IGNACIO**
Dsc (924) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)
- MARTIN, WM. REID, JR.**
Dsc (904) with Jan A. Veltrop of "Theory for the Design of Underground Pressure Conduits" (741)
- MATHEWS, ARCHIE**
See Johnston, Bruce G. (946)
- MATHEWS, C. KELSEY**
"Effect of Air Conditioning on Distribution and Pumping Stations" (889)
- MATTHES, GERARD H.**
Clo (913) of "River Surveys in Unmapped Territory" (612)
Dsc (877) of "Flood-Erosion Protection for Highway Fills" (783)
- MATTHIESEN, R. B.**
Dsc (1112) with R. L. Moore of "Tests on Bolted Connections in Light-Gage Steel" (920)
- MAVIS, F. T.**
See Stelson, T. E. (946)
- MC CLELLAND, BRAMLETTE**
"Soil Modulus for Laterally Loaded Piles" (1081) with John A. Focht, Jr.
- MC CRONE, WILLARD P.**
"Improving the Gulf Intracoastal Canal in Texas" (967)
- MC CUTCHAN, ARTHUR I.**
Dsc (1092) of "Research Needs in Sediment Hydraulics" (953)
- MC DONALD, THOMAS J.**
"Sand By-Passing at a Virginia Tidal Inlet" (976) with Myron A. Sturgeon
- MC DOWELL, E. L.**
"Arching Action Theory of Masonry Walls" (915) with K. E. McKee and E. Sevin
Dsc of 915: A. A. Eremin; Edward Cohen and Edward Laing (1067)
- MC FADDEN, GAYLE**
Dsc of 458: Grant S. Anderson (902)
Clo (902) of "Airfield Pavement Design of the Corps of Engineers" (458)
- MC KEE, JACK E.**
Dsc (905) of "Sedimentation in Rectangular Basins" (687)
See Ingersoll, Alfred C. (1003)
- MC KEE, K. E.**
See McDowell, E. L. (915)
- MC KINNEY, ROSS E.**
"The Role of Chemically Combined Oxygen in Biological Systems" (1053)
Dsc (1003) of "Sanitary Engineers—Their Earnings and Professional Attitudes" (773)
- MC NULTY, JAMES F.**
"Thrust Loading on Piles" (940)
Dsc of 940: L. A. Palmer; David A. Hopkins (1095)
Corr (1028) of "Thrust Loading on Piles" (940)
- MC PHERSON, M. B.**
Dsc of 747: Ahmed Shukry; J. M. Robertson; E. F. Rice (881)
Clo (1092) with H. S. Strausser of "Minimum Pressures in Rectangular Bends" (747)
- MELLINGER, FRANK M.**
"The Design of Non-Rigid Overlays for Concrete Airfield Pavements" (979) with James P. Sale
- MENSCH, L. W.**
Dsc (972) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)

- MERRIAM, CARROLL F.
Dsc (955) with E. T. Schuleen of "Extending Streamflow Data" (826)
- MERRILL, EDWARD A.
"Surveying and Mapping for the Air Force Academy" (923)
- MEYERHOF, G. G.
"Penetration Tests and Bearing Capacity of Cohesionless Soils" (866)
Dsc of 866: Nai-Chen Yang; Sumner G. Hyland; L. J. Murdock; W. J. Turnbull and R. I. Kaufman; and John A. Focht, Jr. (1028)
Dsc of 866: E. de Beer and A. Martens (1095)
Dsc (1028) of "Rupture Surfaces in Sand Under Oblique Loads" (861)
- MICHELIS, CHARLES F.
"Current Trends in Ohio River Traffic and Equipment" (1123) with William F. Lail and Robert E. Mytinger
- MICK, K. L.
Rt "Advances in Sewerage in the Period from October 1, 1954, to December 1, 1955: Progress Report of the Sanitary Engineering Division on Sewerage and Sewage Treatment" (1013)
- MIKLOFSKY, HAAREN A.
Clo (972) of "Bending Interaction in Suspension Bridges" (652)
- MILES, JOHN W.
"Vibrations of Beams on Many Supports" (863)
- MILLER, CARL R.
See Borland, W. M. (903)
See Carlson, Enos J. (953)
- MILLER, LESLIE A.
"Water Resources and Power Studies, Task Force, Hoover Commission: Reclamation and Water Supply" (899)
Dsc of 899: Charles D. Curran (1046)
- MONROE, ROBERT A.
"Design Considerations for a New Lock at Wilson Dam" (1069) with George P. Palo
- MOORE, JOSEPH HERBERT
Clo (877) of "Determining the Required Thickness of Concrete Pavements for Highways" (596)
- MOORE, NORMAN R.
"New Locks on Lower Mississippi and Gulf Coast" (969)
"Old River Diversion Control: Structures Required" (909)
- MOORE, WILLIAM W.
Dsc (904) of "Morro Bay Steam Electric Plant" (737)
- MOORMAN, ROBERT B. B.
Clo (878) of "Continuous Prestressing" (765)
- MOREEL, BEN
"Water Resources and Power Studies, Task Force, Hoover Commission: Organization and Scope: Conclusions and Recommendations" (897)
- MORICE, P. B.
"Prestressed Continuous Beams and Frames" (1055) with H. E. Lewis
- MORSE, E. D.
"Coordinated Mapping and Surveying for Industry" (1064)
- MORTON, J. J.
See Neff, S. G. (950)
- MOSTAFA, M. GAMAL
Dsc of 788: W. M. Borland and C. R. Miller; Serge Leliavsky (903)
Dsc of 788: M. L. Albertson and H. K. Liu (982)
Clo (1111) of "Riverbed Degradation Below Large Capacity Reservoirs" (788)
- MOYER, RALPH A.
"Control of Highway Access: User Benefits in California" (875)
- MUCKEL, DEAN C.
Dsc (903) of "Measurement of Canal Seepage" (728)
- MUILENBURG, GARRETT A.
"The 1954 Drought and its Effect on Ground Water" (1016)
- MULLINS, HOWARD H.
Dsc (1112) of "Influence Lines for Reactions of Continuous Trusses" (914)
- MUNSE, W. H., JR.
See Fuller, J. R. (924)
- MURDOCK, L. J.
Dsc (1028) of "Penetration Tests and Bearing Capacity of Cohesionless Soils" (866)
- MYTINGER, ROBERT E.
See Michiels, Charles F. (1123)
- NAGAI, SHOSITIRO
"Arrangement of Groins on a Sandy Beach" (1063)
- NEELEY, PARLEY R.
Dsc (985) of "Flood-Erosion Protection for Highway Fills" (783)
- NEFF, S. G.
"Project Construction at McNary Dam" (950) with J. J. Morton
- NELSON, HERBERT C.
See Straub, Lorenz G. (1031)
- NEMEROW, NELSON L.
Rt "Air Pollution Studies at University of California at Los Angeles" (1116)
Rt "Evaluation of Water Resources of a River Basin" (1087)
Rt "SED Research Report No. 8: Treatment of Alkaline Sulfur Dye Waste with Flue Gas" (1078)
Dsc of 847: John B. Rowntree (1003)
Clo (1129) of "Experience with a New Type of Dairy Waste" (847)

- NEWMAN, ALLAN**
Dsc (955) of "Integrating the Equation of Gradually Varied Flow" (838)
- NEWMARK, N. M.**
See Veletsos, A. S. (1067)
See Veletsos, A. S. (1112)
- NEWNAM, FRANK H., JR.**
"Developing Port Facilities on Houston's Ship Channel" (965)
- NEWNAM, FRANK R., JR.**
Dsc of 965: Austin E. Brant; Ersel G. Lantz (1124)
- NICOLAOU, STAVROS N.**
Dsc (904) of "Theory for the Design of Underground Pressure Conduits" (741)
- NIMMO, W. H. R.**
Dsc (881) of "The Importance of Fluvial Morphology in Hydraulic Engineering" (745)
- NISHIDA, YOSHICHIKA**
"A Brief Note on Compression Index of Soil" (1027)
Dsc (1028) of "The Action of Soft Clay Along Friction Piles" (842)
- NORTH, LOUIS A.**
Dsc (924) of "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" (809)
- NORWOOD, GUS**
Dsc (1011) of "Principles of Federal Hydroelectric Power Development" (739)
- O'CONNOR, DONALD J.**
"The Mechanics of Reaeration in Natural Streams" (1115) with William E. Dobbins
- OJALVO, MORRIS**
"Internal Ties in Slope Deflection and Moment Distribution" (1096)
- ONDRA, OTAKAR**
"Moment Distribution Constants from Models" (1056)
- ORAVAS, GUNHARD**
"Analysis of Collar Slabs for Shells of Revolution" (916)
Corr (1112) of "Analysis of Collar Slabs for Shells of Revolution" (916)
- ORLOB, GERALD T.**
"Use of Soil Lysimeters in Waste Water Reclamation Studies" (1002) with Robert G. Butler
Dsc of 1002: Ralph Stone (1129)
- OSWALD, WILLIAM J.**
Clo (932) with Harold B. Gotaas of "Photosynthesis in Sewage Treatment" (686)
- OWENS, PATRICK N.**
"Engineering and Malaria Eradication" (1049)
- PACK, DONALD H.**
See White, Fred D. (1001)
- PADERI, F.**
Dsc (881) of "A More Simplified Venturi Tube" (678)
- PALMER, L. A.**
Dsc (1095) of "Thrust Loading on Piles" (940)
- PALO, GEORGE P.**
See Monroe, Robert A. (1069)
- PARME, ALFRED L.**
"Hyperbolic Paraboloids and Other Shells of Double Curvature" (1057)
- PARSONS, JAMES D.**
Dsc (1028) with Ralph B. Peck of "The Action of Soft Clay Along Friction Piles" (842)
- PASCHKIS, V.**
See Weiner, J. H. (946)
- PATTERSON, CALVIN C.**
See Li, Wen-Hsiung (1009)
- PAUW, ADRIAN**
Dsc of 763: J. J. Polivka (878)
Dsc of 763: Wassil Weleff (924)
Dsc of 763: Elio Giangreco (972)
Clo (1067) of "Sequence Summation Factors" (763)
- PEI, M. L.**
Dsc (904) of "Theory for the Design of Underground Pressure Conduits" (741)
- PERREY, JOSEPH I.**
"Use of Zoning Principles in Flood Plain Regulation" (957)
- PETERSON, DEAN F., JR.**
Corr (903) of "Hydraulics of Wells" (708)
See Zee, Chong-Hung
- PETERSON, ELMO G.**
Dsc (878) of "Tightening High-Strength Bolts" (786)
- PICKARD, JEROME P.**
"Industry Location Factors" (886)
- PICKEL, PAUL A.**
See Buettner, Charles E. (1130)
- PIRTZ, DAVID**
See Clough, Ray W. (941)
- PISTER, KARL S.**
See Eresler, Boris (876)
- POCKRAS, HARRY**
See Bailey, S. M. (1128)
- POLIVKA, J. J.**
Dsc (878) of "Influence Lines for Moment and Shear in a Continuous Beam" (734)
Dsc (878) of "Investigation of Floorbeam Hangers in Railroad Trusses" (762)
Dsc (878) of "Sequence Summation Factors" (763)

- POPOV, E. P.**
"Earthquake Stresses in Spherical Domes and in Cones" (974)
See Hirsch, Ephraim G.
- POSEY, C. J.**
Dsc of 783: Carl F. Izzard and Joseph N. Bradley (877)
Dsc of 783: E. W. Lane (877)
Dsc of 783: Gerald H. Matthes (877)
Dsc of 783: Carl E. Kindsvater, Parley R. Neeley (985)
Clo (1093) of "Flood-Erosion Protection for Highway Fills" (783)
- POST, WILFRED M., JR.**
"Transportation Planning: The Airport, A National Facility" (894)
- POWERS, T. C.**
Dsc of 742: A. Hrennikoff, J. Laginha Serafim, and Serge Lelivsky (904)
Dsc of 742: Ross M. Riegel (1094)
Clo (1094) of "Hydraulic Pressure in Concrete" (742)
- PRAGER, WILLIAM**
"Minimum-Weight Design of a Portal Frame" (1073)
- PRICE, PETER**
"Suppression of the Fluid-Induced Vibration of Circular Cylinders" (1030)
Dsc of 1030: G. W. Housner (1091)
- PRIEST, MELVILLE S.**
See Amein, Amein M. (1005)
- PRYOR, WILLIAM T.**
"Experience of the Bureau of Public Roads in Highway Surveys" (1117)
- PYKA, ANDREW JOHN**
"Influence Lines for Reactions of Continuous Trusses" (914)
Dsc of 914: A. C. Scordelis, Robert R. Dickey, A. A. Eremin, and Jacob Karol (1067)
Dsc of 914: Howard H. Mullins (1112)
- RALLS, G. C., JR.**
"A Ripple Tank Study of Wave Refraction" (911)
- RAND, WALTER**
Clo (1010) of "Flow Geometry at Straight Drop Spillways" (791)
- RASMUSSEN, JEWELL J.**
"Economic Criteria for Water Development Projects" (977)
- RATHBONE, T. C.**
Dsc (972) of "Determining Basic Wind Loads" (825)
- RAY, O. B.**
See Turnbull, W. J. (902)
- REDUS, J. F.**
Dsc (902) of "The Effect of Traffic upon Runway Pavement Cross-Section" (720)
- REESE, RAYMOND C.**
"Ultimate Strength Design Under 1956 Building Code" (1099)
- REID, GEORGE W.**
Dsc (1003) of "Planning Sewerage Services for Suburban Areas" (892)
- RENSHAW, CLARENCE**
Clo (913) of "Development of the Delaware River for Commerce" (503) by B. B. Talley
- RICE, E. F.**
Dsc (881) of "Minimum Pressures in Rectangular Bends" (747)
- RICHARDS, R. T.**
"Hydraulic Design of the Sandow Pumping Plant" (948) with E. T. Keck and J. Junget
Dsc of 948: S. Logan Kerr (952)
- RICHARDSON, JOE T.**
Dsc (904) of "Model Tests, Analytical Computation and Observation of an Arch Dam" (696)
- RICHART, F. E., JR.**
Clo (1033) of "Analysis for Sheet Pile Retaining Walls" (694)
- RICHHEIMER, CHARLES E.**
See Smith, David B. (890)
- RIEGEL, ROSS M.**
Dsc (1094) of "Hydraulic Pressure in Concrete" (742)
- RINGO, BOYD C.**
"Limit Design for Buildings" (986)
- RITTER, ROY H.**
Clo (905) of "Design of Treatment Plants for Low Turbidity Water" (591)
- ROBERSON, JOHN A.**
Dsc (1010) of "Lunar-Cycle Measurement of Estuarine Flows" (836)
- ROBERTSON, J. M.**
Dsc (881) of "Minimum Pressures in Rectangular Bends" (747)
- ROBINSON, A. R.**
Dsc of 728: Dean C. Muckel, C. C. Warnick, N. Szalay, and C. W. Lauritzen (903)
Clo (1111) with Carl Rohwer of "Measurement of Canal Seepage" (728)
- ROCHA, M.**
"Arch Dams: Design and Observation of Arch Dams in Portugal" (997) with J. Laginha Serafim and A. F. da Silveira
Dsc of 696: Merlin D. Copen, A. Warren Simonds, Joe T. Richardson, and A. Carvalho Kerez (904)
Dsc of 997: Robert E. Glover (1130)
Clo (1094) with J. Laginha Serafim, A. F. da Silveira and J. M. Ressurreição Neto of "Model Tests, Analytical Computation and Observation of an Arch Dam" (696)
Corr (1130) with J. Laginha Serafim and A. F. da Silveira of "Arch Dams: Design and Observation of Arch Dams in Portugal" (997)

- ROHWER, CARL
See Robinson, A. R. (1111)
- ROOSE, MANLEY A.
Dsc (878) of "Tightening High-Strength Bolts" (788)
- ROSENBLUETH, E.
Dsc (1024) of "Heavy and Tall Building Problems in Mexico City" (917)
- ROSS, DONALD
Clo (876) of "A New Approach to Turbulent Boundary Layer Problems" (804)
- ROTHERUS, VICTOR
"Planned Industrial Districts" (879)
- ROUSE, HUNTER
"Seven Exploratory Studies in Hydraulics" (1038)
- ROWNTREE, JOHN B.
Dsc (1003) of "Experiences with a New Type of Dairy Waste Treatment: Progress Report of the Sanitary Engineering Research Committee, Industrial Waste Section" (847)
- RUBLE, E. J.
"The Painting of Structural Steel" (1100)
- RUNDLETT, J. C.
Clo (924) of "Prestressing Practices in Bridge Building" (733)
- SALE, JAMES P.
See Mellinger, Frank M. (979)
- SALVADORI, MARIO G.
"Bending Stresses in Edge Stiffened Domes" (1021) with Robert Sherman
See Weiner, J. H. (946)
- SALZMAN, M. G.
"Water Supply for Texas Steam Electric Stations" (1044)
- SAMMONS, WILLIAM H.
Dsc (881) of "Synthesis of Rainfall Intensity-Frequency Regimes" (744)
- SANDBERG, C. H.
Dsc of 762: J. J. Polivka (878)
- SARKARIA, G. S.
Dsc (1094) of "Arch Dams: Their Philosophy" (959)
- SAVILLE, THORNDIKE, JR.
"Wave Run-Up on Shore Structures" (925)
- SAWYER, HERBERT A., JR.
Dsc of 851: Bruce G. Johnston (972)
Dsc of 851: Robert L. Ketter, Lynn S. Beedle (1024)
Dsc (972) of "Analysis of Arches by Finite Differences" (829)
- SCHACHERL, ROBERT D.
Clo (877) of "Expedient Geometry for the Design of Compound Highway Curves with Connection Spirals" (500)
- SCHAMBERGER, S. O.
"Experiences with Water Wheel Unit Alignment" (947)
- SCHENKER, L.
"The Dynamic Response of Tall Structures to Lateral Loads" (944)
- SCHJODT, ROLF
Clo (924) of "Calculation of Pressure of Concrete on Forms" (680)
Corr (1112) of "Calculation of Pressure of Concrete" (680)
- SCHONFELD, J. C.
See Dronkers, J. J.
- SCHULEEN, EMIL P.
"Flood Plain Zoning as Supplement to Flood Control" (954)
- SCHULEEN, E. T.
See Merriam, Carroll F. (955)
- SCORDELIS, A. C.
Dsc (972) of "Introduction to Semi-Rigid Determine Polygonal Trusses" (828)
Dsc (1067) of "Influence Lines for Reactions of Continuous Trusses" (914)
- SCRIVENER, L. R.
See Shevling, C. E. (1045)
- SEED, H. B.
Dsc of 842: Lawrence A. DuBose; Yoshichika Nishida; James D. Parsons and Ralph B. Peck (1028)
- SEMENZA, CARLO
"Arch Dams: Development in Italy" (1017)
- SERAFIM, J. LAGINHA
Dsc (904) of "Permeability, Pore Pressure and Uplift in Gravity Dams" (700)
Dsc (904) of "Hydraulic Pressure in Concrete" (742)
See Rocha, M. (997)
- SEVIN, E.
See McDowell, E. L. (915)
- SHELTON, RALPH L.
"Description of Repairs to Spillway Piers of Keokuk Dam" (1133) with Frank L. Burgrabbe
- SHERMAN, ROBERT
See Salvadori, Mario G. (1021)
- SHEVLING, C. E.
"Arch Dams: Design and Construction of Ross Dam" (1045) with L. R. Scrivener
- SHIH, TSZE-SHENG
"Analysis of Ribbed Domes with Polygonal Rings" (1101)
- SHOCKLEY, W. G.
"Foundation Studies for Dredge Piers" (1080) with T. B. Goode
See Turnbull, W. J. (908)

SHUKRY, AHMED

Dsc (881) of "Minimum Pressures in Rectangular Bends" (747)

SHUKRY, ALY S.

See Fathy, A. (1082)

SHULITS, SAM

Dsc (1092) of "Research Needs in Sediment Hydraulics" (953)

SILBERMAN, EDWARD

Dsc (1091) of "The Viscous Sublayer Along a Smooth Boundary" (945)

See Straub, Lorenz G. (1031)

SILVESTER, R.

Dsc (1010) with Alfred S. Harrison of "Integrating the Equation of Gradually Varied Flow" (838)

SIMONDS, A. WARREN

"Arch Dams: Theory, Methods, and Details of Joint Grouting" (991) by A. Warren Simonds

Dsc of 991: R. E. Glover (1046)

Dsc (904) of "Model Tests, Analytical Computation and Observation of an Arch Dam" (696)

SMITH, C. E.

See Bloodgood, D. E. (1083)

SMITH, DAVID B.

"Recovery of Usable Water from Saline Water" (890) with Charles E. Richheimer

SMITH, HUGH A., Jr.

See Von Gunten, Glenn H. (895)

SMITH, ROBERT L.

Dsc (1041) of "Flood Plain Aspects of River Planning" (1040)

SNYDER, WILLARD M.

Dsc (955) of "Extending Streamflow Data" (826)

See Cooper, Alfred J. (883)

SOBOTKA, ZDENEK

Dsc (924) of "Plastic Strength of Steel Frames" (764)

SONEDA, S.

See Coulter, J. B. (1089)

SPANGLER, M. G.

"Stresses in Pressure Pipelines and Protective Casing Pipes" (1054)

SPIELMAN, JOHN V.

Dsc (1095) of "Earthquake Resistance of Rock-Fill Dams" (941)

STANLEY, DONALD R.

Clo (932) of "Sand Filtration Studied with Radiotracers" (592)

STELSON, T. E.

Clo (946) of "Virtual Mass and Acceleration in Fluids" (670) with F. T. Mavis

STERN, ARTHUR C.

"The Federal Air Pollution Research Program" (998)

STERN, E. GEORGE

Dsc (972) of "Load Test of a Diagonally Sheathed Timber Building" (830)

STEVENS, J. C.

"Proportional Weirs for Sedimentation Tanks" (1015)

Dsc of 678: F. Paderi (881)

Clo (1010) of "A More Simplified Venturi Tube" (678)

STONE, RALPH

Rt "Pilot Plant Composting of Municipal Garbage at San Diego, California" (887)

Rt "SED Research Report No. 7: Investigation of Planned Refuse Collection and Disposal" (1014)

Dsc (1129) of "Use of Soil Lysimeters in Waste Reclamation Studies" (1002)

STRAUB, LORENZ G.

"Some Observations on Open Channel Flow at Small Reynolds Numbers" (1031) with Edward Silberman and Herbert C. Nelson

STRAUSSER, H. S.

See McPherson, M. B. (1094)

STREETTER, VICTOR L.

"A Flow Controller for Open or Closed Conduits" (1037)

STREIFF, A.

Dsc (1003) of "Sanitary Engineering Programs of the I.C.A. in the N.E.A. Area" (885) See Lamoureux, Vincent B.

STUBER, H. W.

See C. C. Bonin (1018)

STURGEON, MYRON A.

See McDonald, Thomas J. (976)

SUTER, MAX

"The People Recharge Pit: Its Development and Results" (1102)

SZALAY, N.

Dsc (903) of "Measurement of Canal Seepage" (728)

TALLAMY, B. D.

"Control of Highway Access: Experiences in New York" (871)

TALLEY, B. B.

Clo (913) by Clarence Renshaw of "Development of the Delaware River for Commerce" (503)

TAYLOR, KARL V.

Clo (972) of "Foundation Failures in Residences and Small Structures" (561)

TERRELL, PETE W.

"Design of Stable Canals and Channels in Erodible Material" (880) with Whitney M. Borland

THOM, H. C. S.

Clo (924) of "Frequency of Maximum Wind Speeds" (539)

- THOMAS, HAROLD E.
Dsc (903) of "Water Rights in Humid Areas" (705)
Dsc (903) of "General Aspects of Planned Ground Water Utilization" (706)
- THOMAS, ROBERT O.
Dsc of 706: Harold E. Thomas, Frank B. Clendenen (903)
Clo (1111) of "General Aspects of Ground Water Utilization" (706)
- THOMPSON, THOMAS F.
Clo (942) of "Foundation Treatment for Earth Dams on Rock" (548)
- THON, J. GEORGE
Dsc of 737: Glenn B. Woodruff, Jacob Feld, William W. Moore, and George L. Jordy (904)
Clo (1046) with G. L. Coltrin of "Morro Bay Steam Electric Plant" (737)
- TISON, L. J.
Dsc (955) of "Lunar-Cycle Measurement of Estuarine Flows" (836)
- TONINI, DINO
"Observed Behavior of Several Italian Arch Dams" (1134)
- TRASK, PARKER D.
"Geology of Some American Estuarine Harbors" (956)
- TULTS, HARALD
"Flood Protection of Canals by Lateral Spillways" (1077)
- TURNBULL, J. MACNEIL
"New Test for Control of Cohesive Soils in Rolled-Fill" (933)
- TURNBULL, W. J.
"Old River Diversion Control: Foundation Design" (908) with W. G. Shockley
"Stabilization of Materials by Compaction" (934) with Charles R. Foster
Dsc of 934: G. A. Leonards; John A. Focht, Jr.; E. J. Zagarra; K. B. Hirashima (1095)
Clo (902) of "Base Course and Bituminous Pavement Requirements" (424) with O. B. Ray
Dsc (1028) of "Penetration Tests and Bearing Capacity of Cohesionless Soils" (866) with R. I. Kaufman
- TURNER, HOWARD M.
"History of Power Costs in New England" (1043)
- TUTTLE, EDWARD X.
"Design of the Modern Industrial Plant" (963)
- VAUGHAN, EVAN W.
"Steel Linings for Pressure Shafts in Solid Rock" (949)
Dsc (904) of "Theory for the Design of Underground Pressure Conduits" (741)
- VELETOSOS, A. S.
Clo (1087) with N. M. Newmark of "Natural Frequencies of Continuous Flexural Members" (735)
- VELETOSOS, A. S.
Corr (1112) with N. M. Newmark of "Natural Frequencies of Continuous Flexural Members" (735)
- VELTROP, JAN A.
See Martin, Wm. Reid, Jr. (904)
- VOGELGESANG, CARL E.
"Control of Highway Access: Experiences in Indiana" (873)
- VOLTERRA, ENRICO
"On the Deflections of Bow Girders of Non-Circular Shapes" (870)
- VON GUNTEN, GLENN H.
"Fish Passage Facilities at McNary Dam" (895) with Hugh A. Smith, Jr., and Berton M. Maclean
Dsc of 895: Milo C. Bell (1046)
- WALLACE, WILLIAM
"Trombay Power Station: Cooling Water System" (896) with George E. Archibald
- WARNICK, C. C.
Dsc (903) of "Measurement of Canal Seepage" (728)
- WEBER, EUGENE W.
"Bridge Clearances: Policies and Practice" (935)
Dsc (1111) of "Cost-Allocation for Multi-Purpose Water Projects" (961)
- WEI, BENJAMIN C. F.
Corr (972) to dsc (849) of "Influence Lines for Moment and Shear in a Continuous Beam" (734)
- WEINER, J. H.
Clo (946) of "A Resistor-Network Solution of the Elasto-Plastic Torsion Problem" (671) with M. G. Salvadori and V. Paschakis
- WELEFF, WASSIL
Dsc (924) of "Sequence Summation Factors" (763)
- WELLS, EDWIN A.
"Design of Venturi Flumes in Circular Conduits" (928) with Harold B. Gotaas
- WEN, R. K. L.
Dsc (1112) of "Dynamic Stresses in Continuous Plate Girder Bridges" (973)
- WEYMOUTH, OLIN F.
See Johnson, Reuben J. (1059)
- WHIPPLE, WILLIAM, JR.
Dsc of 739: Ross N. Brudenell (904)
Dsc of 739: Gus Norwood (1011)
- WHISLER, BENJAMIN A.
Dsc of 859: Alfred L. Golze (1125)
- WHISLER, BENJAMIN J.
Clo (1125) of "Education of Civil Engineers: Training for Civil Engineers" (859)

WHITE, FRED D.

"Meteorology as Related to Reactor Site Selection" (1001) with Donald H. Pack

WHITE, WILLIAM A.

Dsc (1066) of "Professional Aspects of Surveying and Mapping" (921)

WHITTON, REX M.

Dsc of 824: Pecos H. Calahan, Francis W. Holden, Robert W. Griffiths (985)

WIEGEL, R. L.

"The Design Wave in Shallow Water" (910) with K. E. Beebe

WILEY, C. C.

Dsc (985) of "The Highway Spiral for Combining Curves of Different Radii" (703)

WILEY, JOHN S.

Rt "Pilot Plant Composting of Municipal Garbage at San Diego, California" (887)

Dsc of 846: P. R. Krige (1048)

Clo (1048) with George W. Pearce of "A Preliminary Study of High-Rate Composting" (846)

WILEY, WALLACE F.

See Hanson, Walter E. (924)

WILLIAM, ROGER H.

Dsc (902) of "The Effect of Traffic upon Runway Pavement Cross-Section" (720)

WILSON, W. T.

See Hershfield, D. M. (955)

WINFREY, ROBLEY

"Highway Engineering Manpower—Recruiting and Training of Graduates" (983)

WING, LESHNER S.

Dsc of 697: Robert F. Krafft (904)

Clo (1046) with Robert R. Griffin of "Selection of Installed Capacity at Hydroelectric Power Plants (697)

WINTER, GEORGE

"Tests on Bolted Connections in Light Gage Steel" (920)

Dsc of 920: R. B. Matthiesen and R. L. Moore (1112)

WINTER, HUGO H.

"Control of Highway Access: Experiences in Los Angeles" (874)

WOOD, W. E.

See Cotton, James A. (927)

WOODRUFF, GLENN B.

Dsc (904) of "Morro Bay Steam Electric Plant" (737)

WOODS, J. W.

See Cawley, W. A. (1084)

XEREZ, A. C.

"Arch Dams: Portuguese Experience with Overflow Arch Dams" (990)

Dsc (904) of "Model Tests, Analytical Computation and Observation of an Arch Dam" (696)

YANG, NAI-CHEN

"Redriving Characteristics of Piles" (1026)

Dsc of 1026: A. A. Eremin (1095)

Dsc (1028) of "Penetration Tests and Bearing Capacity of Cohesionless Soils" (866)

YIH, CHIA-SHUN

Dsc (946) of "Flow into a Well by Electric and Membrane Analogy" (817)

YOUNG, A. C.

"Foreign Operations of the Bureau of Public Roads" (1076)

YOUNG, J. C.

"Economics of Self-Protection of Highways Against Flood Damage" (1075)

ZARTMAN, IRA F.

"Effects of Nuclear Reactor Radiations on Structural Materials" (918)

ZEE, CHONG-HUNG

Dsc of 817: Robert E. Glover, Vaughn E. Hansen, James N. Luthin, and Chia-Shun Yih (946)

Clo (1091) with Dean F. Peterson and Robert O. Bock of "Flow into a Well by Electric and Membrane Analogy" (817)

ZEEVAERT, LEONARDO

"Heavy and Tall Building Problems in Mexico City" (917)

Dsc of 917: E. Rosenbluth (1024)

Clo (1112) of "Heavy and Tall Building Problems in Mexico City" (917)

ZEGARRA, E. J.

Dsc (1028) of "Basic Concepts on the Compaction of Soils" (862)

Dsc (1095) of "Stabilization of Materials by Compaction" (934)

ZIENKIEWICZ, O. C.

"The Effect of Pore Pressures on Stresses in Gravity Dams" (1042)

ZUK, WILLIAM

"Lateral Bracing Forces on Beams and Columns" (1032)